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# ANNUAL REPORTS

OF THE

# DEPARTMENT OF AGRICULTURE

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FOR THE

FISCAL YEAR ENDED JUNE 30, 1898.

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REPORT OF THE  
SECRETARY OF AGRICULTURE.  
DEPARTMENTAL REPORTS.

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REPORT  
OF THE  
SECRETARY OF AGRICULTURE.

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# REPORT

## OF THE

### SECRETARY OF AGRICULTURE.

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#### TO THE PRESIDENT:

I have the honor to submit a report of the work of the Department of Agriculture for the year ending June 30, 1898. This report contains a review of the operations of the several Bureaus, Divisions, and Offices through which the work is carried on. For your own convenience and that of those who shall have occasion to peruse this report, I have preceded this general review with a summary, in which some salient feature of the work undertaken by each of these several Bureaus, Divisions, and Offices is very briefly indicated. I also present several considerations of a more general character relating to the work of the Department and the services which I conceive it should seek to render to the country, upon which I have based some earnest recommendations, and which have also been made the basis for some of the estimates submitted by me for the appropriations for the Department for the ensuing fiscal year, and to which the favorable consideration of Congress is earnestly invited.

#### SUMMARY.

##### WEATHER BUREAU.

Observation and forecast stations have been extended around the Caribbean Sea, to warn our fleets and merchant vessels of danger from cyclones, and increased through the interior of the country, especially in the mountain States, to enable the observer to inform fruit growers of precipitation and sudden changes of temperature.

##### DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.

Good work has been done by the Division of Vegetable Physiology and Pathology in hybridizing the orange and other citrus plants, and in the crossing of pineapples, whereby the size and vigor of the fruit are much increased and the flavor greatly improved.

##### SECTION OF FOREIGN MARKETS.

Our knowledge of the islands of the Caribbean and China seas is increased by timely publications of the Section of Foreign Markets.

Our foreign trade in agricultural products is very extensive, being over two-thirds of our domestic exports. It is steadily growing, while the production at home of field products that have been introduced from foreign countries is rapidly increasing, causing a corresponding decrease in agricultural imports.

#### BIOLOGICAL SURVEY.

While the Department is searching the world for seeds and plants to diversify our crops and add new varieties to meet sectional requirements, the Biological Survey is determining the areas best adapted to various crops and mapping the natural life zones of the United States. It is a court of last resort, where birds and animals get a final hearing regarding their relations to the farm and orchard. Their stomach contents witness for or against them.

#### FARMERS' BULLETINS.

The Department is unable to give Members of Congress as many Farmers' Bulletins as their constituents desire. As fast as scientists find facts bearing on production, I think it wise to send them to the farmers. The farmers want them, Congressmen desire to send them, and appropriations to this end should be enlarged.

#### SCIENTIFIC EXPLORATION.

The Department has four scientific explorers abroad, getting seeds and plants—one in Russia, one in the countries around the Mediterranean, one in the China seas, and one in South America.

#### FORESTRY.

The treeless region is now getting vigorous attention from our Forester. Species adapted to dry regions are being introduced. The destruction of forests in the Northwest leaves deserts in many cases. The life history and rate of development of white pine has been investigated and facts concerning it are in press. The new chief, Mr. Pinchot, is planning to introduce better methods of handling forest lands in public and private ownership, the private owners paying the expenses of Department agents who give instruction. A million acres in twenty States are offered for experimentation and 100,000 acres are now under management. Economic changes in lumbering will be the result. Forest fires cause floods and droughts and consequently interfere with production, especially in irrigated regions. A study of fire prevention and fire fighting is being made. Wood supply is becoming a matter of such interest that the Department deems it wise to give it special attention.

#### SOILS AND TOBACCO.

Many States are interested in the heredity, flavoring, and fermentation of tobacco, and the Department has these features under



research. Farmers in the mountain States, who are making their lands sterile by using too much water, require information regarding its use in irrigation. The Division of Soils is getting facts for them.

#### POST-GRADUATE WORK IN THE DEPARTMENT.

After graduation at agricultural colleges, the Divisions of the Department of Agriculture might be opened for post-graduate study in special lines, so that the best facilities in the land may be offered for preparing teachers for the agricultural colleges and economic scientists for Department work.

#### THE GRASSES.

The best pastures produce animals at least cost. The Division of Agrostology studies grasses and the grass requirements of localities. Five hundred varieties grow in the Department gardens, and grasses suitable for pastures, lawns, woods, and sand are studied. Foreign grasses are tried in congenial zones. Legumes are brought from abroad to meet peculiar conditions here. We have grass gardens in arid and semiarid regions, where varieties from similar conditions in the Old World are studied. The Department is endeavoring to find grasses and legumes for worn-out lands in the East and South, and binding grasses, to arrest sand-drift, are getting attention.

#### DIVISION OF BOTANY.

The Division of Botany is at work to reduce our importations of the little things that have been costing us \$8,000,000 annually. Western States are now growing chicory. In 1896 we imported 16,317,888 pounds; in 1898 we imported only 315,707 pounds of raw chicory. The farmers of Michigan, Nebraska, and other States will now furnish our supply. Ginseng is also a promising plant for cultivation. This Division will make tests to protect farmers and merchants against foul and fraudulently imported seeds, and test the importations of the Department before distribution.

#### ECONOMIC CHEMISTRY.

We are not giving economic chemistry the attention it deserves. We pay foreign countries very large sums for coal-tar products, for example, while we have skilled chemists, capital, and raw material in abundance at home. Our raw material is wasted along these lines, while we are content to buy abroad; we employ, indirectly, foreign chemists to work up for us foreign raw material. Attention to this by the law-making power will find the remedy.

#### CROP STATISTICS.

The reason for having a Division of Statistics is that it will collect and publish information regarding the condition, acreage, and tendency of production of the principal crops, and the number of farm

animals at home and abroad, so that the isolated producer may get notice of quantities and probable demand as soon as those who deal in these commodities. When this is well done, its value to the producer is inestimable. Strenuous efforts are being made to get the truth concerning production, and great care is taken to publish results for general information only.

#### AGRICULTURE IN ALASKA.

A practical scientist was sent to Alaska to select sites for experimental work—to test grains and grasses, legumes and vegetables, and study the possibilities of future production. He grew all of these crops with great success. Alaska will grow, along the coast, oats, barley, flax, rye, grasses, legumes, and vegetables of as good quality as many of our Northern States produce. All the conditions for making fine dairy products are favorable. We shall have the interior explored next summer, in order that its capacity to support population may be learned.

#### ROAD INQUIRY.

Good roads save time and expense. Steel rails are perhaps the coming material where hard rock is not convenient.

#### EXPERIMENT STATIONS.

The experiment stations are more effective than ever before. The annual appropriation by Congress of \$720,000 is supplemented by \$400,000 from the States, and the stations are doing more original work. The Department presents their results in Farmers' Bulletins. The feeding of mankind is being studied in connection with State institutions, and information is distributed to form the basis of courses of instruction. All of our country west of the Missouri River is interested in irrigation, and facts are being collated regarding soil moisture, the supply and distribution of water, uniformity of laws and court decisions relating to irrigation, and the requirements of different crops in this regard.

#### NATURE STUDY IN THE COMMON SCHOOLS.

Congress endowed agricultural colleges that are revolutionizing methods of production. Nature studies, however, should be introduced into the common schools, so that the young farmer's mind may be turned early to life-work studies. The teacher should get instruction in the normal school or agricultural college.

#### ANIMAL INDUSTRY.

##### REMEDY FOR FEVER TICKS OF CATTLE.

The Bureau of Animal Industry has had remarkable success in perfecting a dip that takes the fever ticks from cattle, making it practicable to move them North at any season of the year. This will



enable stockmen south of the quarantine line to develop their herds, to get the benefit of Northern markets at all times, and also to justify feeders and grazers in the North in purchasing stock cattle when surplus grains and pastures make it desirable. The value of this work to both sections is beyond computation. Demand is increasing at home and abroad for fine beef, and this discovery removes one of the impediments to its production.

#### REMEDY FOR HOG CHOLERA.

The Bureau has continued experimentation with antitoxin serum for the prevention and cure of hog cholera. Congress, at its last session, made an appropriation for this work, which became available at the beginning of the present fiscal year. Buildings were erected at our experiment station, and animals purchased to make the serum in sufficient quantities to conduct extensive research. The results of the previous year have been corroborated. Eighty per cent of the animals treated were saved, while a like per cent of the check herds not treated died. This justifies the Department in efforts to supply in future to herdsmen throughout the country such serum as can be made. It is for Congress to determine whether serum shall be given free or a charge be made covering the expense of manufacture, which would be about 15 cents for each animal.

#### EMERGENCY APPROPRIATION.

The nature of the work in the Department is such that future requirements can not all be anticipated specifically in an appropriation bill. Urgent needs of producers call for expenditures in special directions through some of our scientific Divisions; the sudden appearance of a bacteriological or insect pest; investigation of animal or crop conditions in some section of the country; inquiry into conditions in foreign countries where we sell or with whom we compete; assistance to a struggling scientist to complete work of general agricultural interest; exploration by scientists of islands coming into the possession of the United States, and such like, suggest the wisdom of appropriating a lump sum to be used by the Secretary of Agriculture, subject to the laws regarding vouchers and auditing.

#### INSPECTION OF FOREIGN GOODS.

There is an evident necessity for the inspection of many articles imported from foreign countries that contain substances injurious to the public health. The Department chemists are doing work along this line which suggests a more comprehensive inquiry. At present the Department buys samples for analysis in the open market. It may be necessary, where there is ground for suspicion and a necessity for the identification of source, to open packages at ports of entry, as it is proposed in foreign countries to do with our exports in certain cases.

## BUTTER SHIPMENTS

The experimental exports of butter by this Department to Great Britain, which were commenced in the spring of 1897 and partially reported upon a year ago, were continued until the close of the active creamery year of 1897 and resumed at the opening of the season of 1898 upon an enlarged scale.

Without anticipating the results of the present (or second) season of these trial exports, it can now be confidently stated that much additional information has been obtained in the line desired, and a decided gain is evident in the favorable impression made by butter of the first quality from creameries in the United States upon the best class of the butter trade in London and Manchester.

## THE DEPARTMENT LIBRARY.

The books of the late Prof. F. von Baur, of Munich, have been added to the collection on forestry in the Department Library, making that collection very complete. The total number added during the year was nearly 5,000, bringing the whole number of volumes in the Library close to 65,000. This forms one of the largest collections of books on agricultural topics in the world.

The Library is constantly used in the investigations conducted by the scientific Divisions, and is kept up to date in its various branches by the purchase and addition of the latest standard publications relating to matters in which the Department is interested. It is also used to a considerable extent by persons not connected with the Department, especially by teachers in the public schools and by students in the science classes of the various educational institutions of the city.

## EXPERIMENTAL GARDENS.

The distribution of young plants to various parts of the country was continued during the year, reaching a total of nearly 190,000, including bulbs. Among these were olive, fig, and camphor plants and cuttings. Attention is called to the fact that the growing of rubber plants even in the most favorable localities of Florida can hardly be commercially successful.

The propagation of plants for general distribution has been continued, resulting in the accumulation of many thousands of plants of various kinds.

## PARIS EXPOSITION IN 1900.

Congress has imposed upon the Secretary of Agriculture the duty of preparing for the Paris Exposition in 1900 an exhibit covering the agricultural resources of the United States (Groups VII, VIII, and X—Agriculture, Horticulture, and Food Products). I am fully alive to the importance to American agriculture of this opportunity to enlarge the knowledge and appreciation of the people of the Old

World of the extent and variety of the products which the bounty of nature enables the American farmer to draw from Earth's prolific bosom. The first steps have been taken after consultation and in cooperation with the Commissioner-General, and every effort will be made to see that American agriculture is properly represented at this great celebration. Should the appropriations already provided prove inadequate, I feel confident Congress will not hesitate to enlarge them rather than to have this important exhibit lacking in any single respect.

#### **PRACTICABILITY OF EXPORTING DAIRY PRODUCTS.**

Owing to better home demand for dairy products, it is not commercially profitable to send butter to Europe at the present time. The home demand for our best butters absorbs the supply. This is not always the case, however, and the Department regards it wise to obtain for dairymen all the facts relating to the export of this article to the several commercial centers of both continental and insular Europe. For this purpose the Department sent an agent to Paris to ascertain what encouragement there would be to ship butter to that port. It was found that no line of steamers sailing direct from the United States to French ports could furnish refrigerator space, and so shipments could not be made during the heated period. An agent was also sent to Hamburg, to ascertain for our people what the facts are regarding customs duties, as well as prohibitions and other difficulties that might meet exporters of butter to that country.

Our finest butter can be profitably made and sent to both France and Germany whenever the home supply is greater than the home demand for first-class goods. The American farmer is selling cheap grains and mill feeds to European dairymen, who meet us in European markets with products made from raw material furnished by us. There is every reason to believe that the tendency is growing within our own country toward the consumption of grains and mill feeds at home, exporting the higher-priced products of skill. As our producers manufacture more and more on the farm and the great volume of raw materials is turned into the higher-selling articles, we can furnish fine dairy products to European countries at a lower rate than they can be produced under European conditions on dearer lands and with dearer feeds.

The trade in American farm products is growing in the China seas. Scientific inquiry into the principles that underlie the making of fine dairy products is preparing our people to furnish butter in condition to be exported in air-tight packages, so that they will remain sweet for long periods in tropical countries. In order that markets may be opened up in Japan, China, and other countries of the Pacific Ocean, an agent is now in that region establishing agencies to which the Department will make trial shipments with a view to ascertaining all the facts for the benefit of the dairymen.

## INSPECTION OF DAIRY PRODUCTS.

The existing system of Government inspection and certification of meats and meat products for export may be extended (with suitable modifications) to include butter, cheese, and condensed milk for export from the United States.

The combined efforts of the Government and of commercial enterprise may succeed in the early establishment of a high reputation for American butter in desirable foreign markets. But as soon as accomplished, this becomes liable to be destroyed by the cupidity of those who, trading on this reputation, flood the same market with butter of low grade, yet still entitled to export and sale as "produce of the United States." This will disgust merchants and consumers alike and reverse the reputation of our butter, just as the fine market in Great Britain for our cheese was recently ruined by the quantity of low-grade and counterfeit cheese which was exported without being marked to show its true character.

The remedy seems to lie in extending and adapting the provisions of law regarding the inspection of meats exported from this country so as to make them apply to butter and cheese. The brands of "pure butter" and "full-cream cheese" should then be affixed by United States inspectors to such products only as are of a fixed minimum standard of quality. Such precautions, duly legalized and properly executed, would place the good butter and cheese of this country in foreign markets under the identifying label and guaranty of the United States Government, leaving similar merchandise of lower grade to find a place for itself, upon its own merits. It should be borne in mind that dairy products of Denmark and Canada, which are the chief competitors of the United States in the markets of Great Britain, bear the inspection certificate and guaranty of quality from their respective Governments, and thereby maintain a great commercial advantage.

Such a system of inspection is much desired by the most reliable exporters, and the proposition has met with decided approval wherever considered by fair-minded, interested parties.

**NATURE-TEACHING IN THE COMMON SCHOOLS.**

There is growing interest in education that relates to production. All classes of intelligent people favor it. Congress endowed colleges to teach it, and progress is being made, but not so rapidly as the growth of our country demands. More knowledge concerning what the farmer deals with every day would enable him to control conditions, produce more from an acre, and contribute more to the general welfare. The education of our people in common school, high school, and college has not been designed to prepare them for producing from the soil, excepting the very few who have found their way into our agricultural colleges. It is evident to educators in agricultural



science that elementary study should be introduced into the common schools to give direction early in life.

Agriculture, horticulture, forestry, gardening, and landscaping are delightful studies that attract people in all walks of life, but there is enough to be learned regarding each of these to require the devotion of a lifetime. The colleges and experiment stations endowed by the Federal Government provide for training along this line for longer or shorter periods at the institutions of the several States and Territories designed for this purpose; but while encouraging progress has been made in building up courses in these institutions that teach the sciences relating to production, instruction before going to college and after graduation is lacking. Nothing is being done in most of the common schools of the States to cultivate a taste for and lead the mind to inquire into and store up facts regarding nature, so that the young farmer may be directed into the path that leads to education concerning his future life work.

The great prerequisite is the education of the teacher. Most of the States have institutes where teachers are required to assemble for instruction in their work; there they should be met by lecturers from the agricultural colleges who may be qualified to outline methods of nature studies in the common schools. The normal schools of the States could give courses of instruction along these lines to those who are fitting themselves for teaching in the high schools, so that instruction of a more advanced character might be given their graduates, preparing them for and inclining them toward, the agricultural college.

#### PRACTICAL EXPERIMENTS IN NATURE TEACHING UNDER STATE AUTHORITY.

In New York, the College of Agriculture of Cornell University has a special State appropriation of \$25,000 per annum to be used in aiding the introduction of nature teaching into the common schools and the carrying on of simple agricultural experiments in different parts of the State. The plan followed has been to employ experts in the different sciences to prepare brief leaflets containing lessons on different subjects for the use of teachers in the common schools. These leaflets are distributed to teachers throughout the State, and there has been such a large demand for them from teachers in other States that arrangements have been made to sell them at a nominal price.

The professors and other agents of the university attend meetings of teachers from time to time, to explain the scope of this work and to show the teachers how to carry out simple instruction on nature topics. Many of these leaflets relate directly to agricultural subjects. For example, in one leaflet the teacher is instructed to have the children plant squash seeds, take some of them up at intervals to learn how the seeds germinate, and watch what happens to the little plants as they grow. At another time the children are encouraged to plant

little gardens and carefully watch some of the things that grow in them; or they study some insect which preys upon fruit, or make collections of the insects about their homes, or watch them to see whether they are doing things good or bad for the farmer. This movement has rapidly increased in popularity, and the leaflets are used in many city schools as well as in those in the country. Hundreds of simple experiments with fertilizers on potatoes have been carried on in different parts of the State with some of the money above referred to. For carrying on all this work the university has employed its teaching force and a small corps of special agents and clerks.

In Indiana, Purdue University has undertaken a similar work, though its funds have not permitted it to make it very extensive. A number of leaflets have been prepared by different members of the faculty and have been sent out to teachers throughout the State. In a number of other States nature teaching has been introduced into the common schools, but for the most part in the schools in the larger towns and cities, where there were teachers who had had some training in natural science. As a result of the widespread interest on this subject, teachers' manuals and text-books for instruction in this branch are being prepared.

Without doubt the greatest difficulties in this matter are to overcome the conservatism of local boards managing the country schools and to get competent teachers.

#### **FACILITIES OF THE DEPARTMENT FOR POST-GRADUATE INSTRUCTION IN AGRICULTURAL SCIENCE.**

George Washington, by his will, left property to be devoted to university education in the District of Columbia. There is no university in the land where the young farmer may pursue post-graduate studies in all the sciences relating to production. The scientific Divisions of the Department of Agriculture can, to some extent, provide post-graduate facilities. Our chiefs of Divisions are very proficient in their lines; our apparatus the best obtainable; our libraries the most complete of any in the nation. We can direct the studies of a few bright young people in each Division, and when the Department requires help, as it often does, these young scientists would be obtainable.

They should be graduates of agricultural colleges and come to the Department of Agriculture through a system of examination that would bring the best and be fair to all applicants. The capacity of the Department is limited, but something can be done that will indicate to Congress its value. The Department often needs assistants to take the place of those who are tempted to accept higher salaries in State institutions. The opening of our laboratories to post-graduate work would provide an eligible list from which to fill vacancies as they occur, supply temporary agents, and be a source from which State institutions might get assistants in scientific lines.

**INVESTIGATION OF AGRICULTURAL RESOURCES OF INSULAR  
DEPENDENCIES OF THE UNITED STATES.**

In the territories recently brought under the control of the United States Government the agricultural interests urgently call for attention by this Department. While in all countries the agricultural industry is admittedly of the first importance, this is especially true of Hawaii and the West India Islands, which depend almost exclusively for their prosperity upon their agricultural productions. It behooves the Department to place itself at the earliest moment possible in a position to extend to the agriculturists of those territories which have, or may, come under the United States flag, the services and benefits which it renders to the farmers of the United States. The increased trade relations which may be looked for between the United States and its insular dependencies, moreover, render the conditions of agriculture in the latter and the character and extent of their productions matters of profound interest to the people of the United States. In the interest of our own agriculture, not only must the agricultural resources of these islands then be studied closely and intelligently, but the dangers which threaten agriculture in these territories in the form of plant diseases or insect pests must be made the subject of special investigation with a view to provide agriculture there with preventive or remedial agencies, and also to secure our own agriculture from the possibility of their introduction into this country. It is urgently necessary, therefore, that Congress should as speedily as possible provide a sufficient fund for the use of this Department in making such investigations as may be necessary into the agricultural resources and conditions in Hawaii, Puerto Rico, Cuba, and the Philippines.

**WEATHER BUREAU.**

The presence of more than two hundred naval and transport vessels belonging to the United States in West Indian waters made it apparent during the latter part of the fiscal year that the methods of gathering information of the approach of West Indian hurricanes were wholly inadequate. The safety of the fleet during the time of severe atmospheric disturbances made it imperative that precautionary measures should be taken at once.

**OBSERVATION STATIONS IN WEST INDIES AND ON CARIBBEAN SEA.**

A bill was therefore drafted and submitted to Congress June 16, 1898, authorizing the establishment and operation of observation stations throughout the West Indies and along the shores of the Caribbean Sea. The provisions of the measure were incorporated in the general deficiency bill, but did not become law until after the close of the fiscal year.

Arrangements had already been made, however, to establish stations for making meteorological observations and displaying hurricane signals at Kingston, Santiago de Cuba, Santo Domingo, St. Thomas, Barbados, Dominica, Trinidad, Curaçao, and Barranquilla.

When the West Indian service is fully established twice-daily reports will be received, not only from the stations named, but also from Habana, Nassau, Vera Cruz, Tampico, Coatzacoalcos, and Merida.

Although the primary object of the extension of the storm-warning system to the West Indies was the protection of our large naval force, other considerations of great importance make it a wise and beneficent undertaking, and the improved storm-warning service will largely benefit the commercial interests throughout the West Indies.

The Central Meteorological and Magnetic Observatory of Mexico has begun the equipment of about thirty stations in the Mexican Republic, with the most approved meteorological instruments, and will establish a meteorological service similar to our own. When completed, an exchange of reports, especially those relating to the approach of West Indian hurricanes and "northers" in the Gulf of Mexico, will be effected.

#### NEW STATIONS IN ARID AND SUBARID REGIONS.

Congress last session made an appropriation for the purpose of increasing the number of stations in the arid and subarid regions of the country, and provision has already been made to establish stations at Kalispell, Mont.; Boise, Idaho; Mount Tamalpais, Cal.; Flagstaff, Ariz., and Fort Worth, Tex. Additional stations will soon be located at Meridian, Miss.; Macon, Ga.; Lexington, Ky.; Elkins, W. Va.; Evansville, Ind., and Escanaba, Mich. These additional stations, besides assisting in the development of agricultural and industrial interests in the States in which they are located, will be of material benefit in improving the warnings and forecasts, especially for the regions west of the Rocky Mountains.

#### AERIAL OBSERVATIONS.

Aerial observations by means of kites were continued during the year. It was hoped to establish at least twenty stations, but it was found that only sixteen could be completely equipped. The observers chosen for the work were called to Washington and given a practical course of instruction in the art of flying and managing kites. It is too early to express an opinion regarding the value of the observations already secured in the aerial work of the Bureau.

#### LAKE CHARTS FOR VESSEL MASTERS.

To increase the usefulness of the Bureau in the Great Lake region, a monthly chart was issued showing the lake ports at which storm warnings are displayed, the localities in ports where information



respecting the weather can be obtained, the regions of fog, the prevailing winds, and other statistical information respecting the wind and weather on the lakes.

#### LOSSES TO FARM PROPERTY BY LIGHTNING.

The Bureau has begun the collection of statistics of loss to farm property, including live stock in the fields, by lightning, so as to determine the frequency of lightning stroke and the amount of property destroyed annually by that phenomenon.

#### EFFICIENCY OF THE BUREAU.

The efficiency of the Bureau was fully equal to the high standard of the previous year. Four hurricanes which visited the Atlantic and Gulf coasts during the fall were duly announced. The most severe of these storms was that of October 23 to 26, which moved slowly from off the Florida coast to the vicinity of Hatteras. It there increased greatly in intensity, and caused violent northeast gales along the coast as far north as New England.

Owing to the duration of the storm in the vicinity of Hatteras, the Bureau was enabled to make a definite prediction with regard to the tide at Norfolk, Va., where, owing to the low level of the city, much valuable property is liable to damage by inundation. Cotton and other property valued at \$850,000 were removed to places of safety. As a result of the warnings issued for this storm, between 800 and 900 vessels remained in port along the Atlantic coast.

During the prevalence of one of three severe storms which passed from the interior to the eastern seaboard during November, 1897, the steamer *Idaho*, with 19 of her crew of 21, was lost on Lake Erie. This vessel, disregarding the warnings of the Weather Bureau, left Buffalo during the afternoon of the 5th in the face of storm signals which had been flying since daybreak.

A remarkably violent wind and snow storm swept over eastern New York and New England January 31 and February 1, 1898. The greatest violence of the storm was felt along the New England coast, where nearly two score mariners lost their lives and many vessels were wrecked. Warnings of this storm were sent out the morning of the 31st and given the widest possible circulation.

Early in January and February, 1898, forecasts of freezing weather in Florida were made in time to enable the residents of that State to protect their early vegetables and fruit trees. Similar notices were given regarding unusually low temperature in California.

There were five important floods during the year, and but for the timely warnings given by the Bureau the losses would have been much greater than they were.

Forecasts and warnings were at all times distributed with the utmost dispatch, and the daily press has not only greatly contributed

to the success that has attended our efforts in circulating forecasts, but has rendered valuable aid in disseminating special warnings of cold waves, storm winds, frosts, etc.

There has been a great improvement in the instrumental equipment of the Bureau, and no other similar territory in the world is covered with such a complete equipment of instruments, recording climatic and meteorologic phenomena.

#### CLIMATE AND CROP SERVICE IN ALASKA.

An agricultural experiment station having been established in Alaska in April, 1898, an official of the Weather Bureau was sent there to organize a climate and crop service. The central station is located at Sitka, and continuous registers of wind velocity, sunshine, temperature, and pressure will be made there.

#### TELEGRAPH SERVICE.

At one time the Federal Government owned and operated about 5,000 miles of seacoast and frontier telegraph lines. In 1891, 633 miles of these lines, mainly on the seacoast, were turned over to the Weather Bureau. These lines enable the Bureau to receive early information of changes in weather at exposed points on the coast, to display storm warnings near several of the great highways of vessels entering or leaving our ports, and also to contribute largely to the safety of vessels navigating our coasts.

#### STUDY OF METEOROLOGY.

The importance of the study of meteorology in the United States has been kept in mind, especially in the assignment of observers to duty at points where there are colleges or universities not already provided with instructors in meteorology, and during the past year the courses in meteorology have been strengthened in a large number of high schools and academies.

#### NEED OF AN ASSISTANT CHIEF

Almost the entire time of the Chief of the Weather Bureau has during the year been consumed in executive work, leaving him but little time to attend to other duties. That work is constantly increasing, therefore I recommend that an assistant chief of the Weather Bureau be provided for.

#### BUREAU OF ANIMAL INDUSTRY.

##### MEAT INSPECTION.

The Bureau maintains a system of thorough inspection of meat products at one hundred and thirty-five abattoirs in thirty-five

cities. This is an increase of seven abattoirs and two cities over the fiscal year 1897. The work done has greatly exceeded any former year, especially in the matter of pork products. This necessitated a large increase in the force of employees, who were obtained through examination by the Civil Service Commission. Their service has been efficient and satisfactory.

From the tables furnished by the chief of the Bureau of Animal Industry it is learned that during the year there were 9,228,237 ante-mortem inspections of cattle, 10,028,287 of sheep, 468,199 of calves, and 31,610,675 of hogs, making a total of 51,335,398 inspections. This is a total gain over 1897 of 9,025,291 animals, divided as follows: Cattle, 1,178,212; sheep, 1,983,932; calves, 19,216; hogs, 6,043,931. The condemnations at abattoirs were 104 cattle, 741 sheep, 67 calves, and 9,679 hogs—a total of 10,591. The rejections in stock yards were 27,491 cattle, 9,594 sheep, 2,439 calves, and 66,061 hogs—a total of 105,585. The number of condemned animals at abattoirs was 3,275 fewer than in 1897, and the number rejected in stock yards was 27,247 greater. These differences show the careful work of the officials in detecting disease previous to the slaughter of the animals.

The records for the post-mortem work show 4,433,181 inspections of cattle, 5,501,675 of sheep, 245,155 of calves, and 20,936,840 of hogs. Of the carcasses condemned, 10,018 were of cattle, 3,567 of sheep, 344 of calves, and 77,579 of hogs; and of the parts of carcasses condemned, 12,591 were of cattle, 287 of sheep, 52 of calves, and 35,250 of hogs.

In addition to the above there were killed by city inspectors 1,785 cattle, 1,509 sheep, 192 calves, and 14,698 hogs which had been rejected in the stock yards by officers of the Bureau of Animal Industry.

The meat-inspection tag, or brand, was placed on 14,815,753 quarters and 968,014 pieces of beef, 5,448,477 carcasses of sheep, 217,010 carcasses of calves, 680,876 carcasses of hogs, and 394,563 sacks of pork.

The meat-inspection stamp was affixed to 4,433,569 packages of beef products, 5,163 packages of mutton, and 10,145,048 packages of hog products, of which 374,131 contained microscopically-examined pork.

The number of cars sealed containing inspected meat for shipment to packing houses and other places was 18,631.

There were issued 25,267 certificates for meat products which had received the ordinary inspection—these covered exports comprising 1,256,716 quarters, 67,120 pieces, and 735,814 packages of beef, weighing 339,650,091 pounds; 5,163 packages of mutton, weighing 324,996 pounds; 39,212 hog carcasses and 653,564 packages of pork, weighing 244,956,482 pounds.

The cost of this work was \$409,138.09, which makes an average of 0.8 cent for each of the 51,335,398 ante-mortem inspections,

besides covering all the subsequent work of post-mortem inspection, tagging, stamping, etc.

The cost of inspection has been growing gradually less year by year. The average cost per head was  $4\frac{3}{4}$  cents in 1893,  $1\frac{3}{4}$  cents in 1894, 1.1 cents in 1895, 0.95 cent in 1896, and 0.91 cent in 1897.

The number of animals inspected before slaughter is shown in the statement below. The figures for 1897 are given also as a means of comparison:

*Animals inspected before slaughter for abattoirs, 1897 and 1898.*

Fiscal year.	Cattle.	Calves.	Sheep.	Hogs.	Total.
1897.....	4,289,058	259,930	5,179,643	16,813,181	26,541,812
1898.....	4,552,919	241,092	5,706,092	20,713,863	31,213,966
Increase .....	263,861	$\alpha$ 18,848	526,449	3,900,682	4,672,154

$\alpha$  Decrease.

#### MICROSCOPIC INSPECTION OF PORK.

The examination of pork and pork products shows that better results are obtained by making the inspection in the carcass than when samples from cured meat are examined. The following table shows this fact quite clearly:

*Comparison of inspections from carcasses and from pieces.*

Samples.	From carcasses.		From pieces.	
	Number.	Per cent.	Number.	Per cent.
Class A.....	1,892,131	98.148	864,042	98.747
Class B.....	15,729	.816	5,064	.579
Class C.....	19,978	1.036	5,902	.674
Total .....	1,927,838	100	875,008	100

The samples of pork submitted for microscopic examination were classified as follows: Class A, samples in which no sign of trichinæ, living or dead, or calcified cysts are found; Class B, samples in which degenerate trichinæ cysts are found, but in which the body of the parasite is not recognizable; Class C, samples in which recognizable bodies, living or dead, of trichinæ are found. All hogs belonging to the latter class must be condemned and disposed of according to section 20 of the regulations dated June 14, 1895.

The number of certificates issued for microscopically examined pork was 20,158, covering shipments aggregating 373,366 packages, weighing 120,271,659 pounds. Of this quantity, 698 packages, weighing 161,303 pounds, were exported to countries not exacting a certificate of microscopic inspection.



The cost of microscopic inspection was \$171,040.94, an average per specimen examined of 6.1 cents, or an average of 0.142 for each pound exported. This cost per pound for the inspection of pork shows a remarkable reduction from the cost in 1897, when it was 0.256 cent. The cost in 1896 was 0.264 cent; in 1895, 0.2 cent; in 1894, 0.248 cent.

The microscopically inspected pork for 1898 reached the enormous amount of 120,271,659 pounds. Only 161,303 pounds of this went to countries not requiring inspection. In 1897, 43,572,355 pounds of pork were inspected microscopically, 1,001,783 pounds of which went to countries not requiring inspection. These figures show that countries requiring inspection received from us in 1898, 120,110,256 pounds of pork, as against 42,570,572 in 1897—an increase of 77,539,784 pounds. It is worthy of note here that the amount of pork microscopically inspected in 1898 exceeded the total amount of the three previous years by 18,703,906 pounds.

The number of samples examined increased 49 per cent over last year, the expense increased 53 per cent, and the exports increased 176 per cent.

#### INSPECTION OF VESSELS AND OF ANIMALS FOR EXPORT.

The number of inspections of American cattle for export was 859,346, and 1,438 head were rejected; 297,719 inspections of American sheep were made and 180 head rejected. The number of Canadian cattle inspected was 19,397, of which 5 were rejected; 29,497 Canadian sheep were inspected and 38 of them were rejected.

The number of clearances of vessels carrying live stock was 971, as against 954 in 1897.

Inspectors of the Bureau of Animal Industry in Great Britain inspected cattle from the United States to the number of 381,420 and sheep to the number of 151,863; cattle from Canada, 17,164; sheep from Canada, 27,912. This shows an increase of 20,898 cattle and a decrease of 9,408 sheep when compared with the report for 1897. The number of head of cattle lost in transit in 1897 was 2,323, or 0.61 per cent, as against 907 head or 0.23 per cent for this year. The number of sheep lost in transit in 1897 was 2,676, or 1.39 per cent, as against 1,618, or 0.89 per cent, for this year.

The cost of the inspection of export animals, the supervision of Southern cattle transportation, and the inspection of animals imported from Mexico was \$101,210.55. It is estimated that half of this expense is on account of the export inspection, and, with this as a basis, the cost of inspecting the 548,419 domestic cattle and sheep exported was \$50,605.28, or 9.2 cents per head. The number of inspections made of these animals in this country was 1,157,065, and in Great Britain 533,283, making a total of 1,690,348, the average cost of each inspection being 2.99 cents.

Following is a statement showing the inspection of domestic cattle and sheep for export, and number exported for 1898, compared with 1897:

*Inspections and exports of domestic cattle and sheep, 1897 and 1898.*

Year.	Cattle.		Sheep.	
	Number of inspections.	Number exported.	Number of inspections.	Number exported.
1897 -----	845,116	390,554	348,108	184,596
1898 -----	859,346	400,512	297,719	147,907
Increase (+) or decrease (—) -----	+ 14,230	+ 9,958	— 50,389	— 36,689

#### SOUTHERN CATTLE INSPECTION.

During the quarantine season of 1897 there were received and yarded in the quarantine division of the various stock yards 35,317 cars, containing 972,224 cattle; the number of cars cleaned and disinfected was 35,280.

In the noninfected area in Texas 225,096 cattle were inspected for the identification of brands, prior to removal to other States for grazing.

#### INSPECTION OF IMPORTED ANIMALS.

The number of animals imported from Mexico and inspected at the ports of entry along the boundary line comprised 177,772 cattle, 64,207 sheep, 104 swine, and 3,053 goats.

There were imported from Canada for slaughter, milk production, grazing, feeding, etc., and not subject to quarantine detention, 79,907 cattle, 184,352 sheep, 374 swine, 2,998 horses, 2 goats, 8 mules, 1 deer, and 6 buffalo, of which 385 cattle, 6,867 sheep, and 217 swine were for breeding purposes.

#### INSPECTION OF HORSES AND HORSE PRODUCTS.

The appropriation bill for the fiscal year 1899 contains a provision "that live horses and the carcasses and products thereof be entitled to the same inspection as other animals, carcasses, and products thereof" named in the bill. Two abattoirs have so far been established, one at Linnton, Oreg., and one at Brighton, Mass. The latter has been in operation but a few days. The former commenced operations on August 1, and during that month 721 horses were inspected, 88 of which were condemned. In September there were 905 inspections and 33 condemnations. The percentage of condemned animals is large, and is an indication that no mistake is made in extending inspection to horses. These abattoirs slaughter horses exclusively.

Regulations are being formulated for the inspection of live horses for export. It is believed such inspection will stimulate the demand

abroad for our horses, especially in England, where the question of inspection of American horses has already been discussed to some extent.

#### PAYMENT FOR MICROSCOPIC INSPECTION.

While the work at the abattoirs becomes more thoroughly systematized from year to year and the cost of inspection per pound of meat has become gradually less, the great extension of the work necessarily increases the total expenditures. The question as to whether the Government should continue to pay the cost of this inspection, or whether the expense should be borne by the slaughterers, is one which, in my opinion, ought to receive early consideration. As bearing upon this feature of the question, I quote from my report for 1897:

While I believe the general inspection of meat for sanitary purposes should be made by the Government, without charge to the slaughterers, the microscopic inspection to a great extent is a commercial inspection, and the cost of it could be more legitimately assessed against the trade which it benefits. If the packers paid the cost of the inspection there would be no longer any reason for declining to extend it to all who apply for it.

#### EXPERIMENTS WITH HOG CHOLERA.

The experiments conducted in the fall of 1897 upon hog cholera and swine plague proved so encouraging that Congress made a special appropriation for the purpose of continuing the work. The bill was late in passing, and further time was consumed in making the necessary preparations to carry on the work on a sufficiently practical scale. Material to inject about 1,000 animals was sent to the agent of the Bureau of Animal Industry in Iowa, where the first test is being made, and reports already received indicate that about 80 per cent of the animals treated were saved, while in the check herds barely 20 per cent were saved.

On account of the time required to secure a supply of this serum, the quantity so far produced has not been adequate to give sufficient data upon which to base definite conclusions; but the results so far obtained are gratifying indeed, and it is deemed advisable to continue the work another year. The production of serum is being steadily increased, and in a short time a large and regular output will be assured. It remains only to test the remedy upon a sufficient scale and to perfect the method of procedure.

A grave question now presents itself in connection with this subject. I refer to the manufacture of the serum in quantities sufficient to supply the prospective demand. The necessity for its manufacture without the temptation inseparable from purely commercial undertakings to cheapen the product is manifest. It is obviously of the utmost importance that this serum should be produced of the requisite strength and purity until the efficacy of the treatment is thoroughly understood and appreciated and a reliable standard is established, as

in the case of other remedial agents, and the interest of the public demands that this discovery, having been made by public officials at public expense, should not be diverted to private profit. It must be supplied for the benefit of all at a minimum cost; and, under the circumstances, I can see no alternative but that the manufacture should be continued under Government control, at least for some years to come.

#### TUBERCULOSIS.

The study of tuberculosis, with reference to both men and animals, has been continued, and the results so far obtained indicate that experiments already begun in this line should be continued, as there is a prospect of more satisfactory results.

#### TEXAS FEVER.

Experiments in dipping cattle to kill the ticks which cause Texas fever were continued, with the gratifying result that a substance has been found which will destroy all the ticks on an animal at a single dipping and which will not injure the animal. In order to test the experiment on a large scale, about a thousand head of cattle were dipped at Fort Worth, Tex., and thence shipped to northern Illinois and placed in pastures with susceptible cattle. The ticks were all killed by the dipping and the cattle did not communicate the fever to the susceptible cattle. An equal number were dipped at Mammoth Spring, Ark., with equally successful results. The importance of this measure can hardly be overestimated, and prominent stockmen consider that it is worth millions of dollars, both to cattle raisers below the quarantine line and to the feeders and grain producers north of the line.

These encouraging results have led to a demand for dipping stations at many other points, and arrangements are now being made for securing the establishment of such stations before the next quarantine season at points convenient for shipment and inspection.

#### INVESTIGATION IN BLACKLEG.

The demand for blackleg vaccine has increased very much during the year. More than 355,000 doses have been sent out. The results received from its use indicate that the percentage of loss in herds has been reduced from 10 to 20 per cent to less than 1 per cent. This means not only an immense saving to cattle raisers, but, if generally used, will tend to eradicate the disease completely.

#### DIVISION OF CHEMISTRY.

The Division of Chemistry during the past year has continued its work on the composition and adulteration of foods. An elaborate bulletin, treating of the composition of cereals and all cereal products,



represents the results of the principal amount of work in this direction. Another bulletin is devoted to the composition and uses of Indian corn, and this bulletin was prepared especially for presentation at the Third International Congress of Applied Chemistry in Vienna, which met in July, 1898. The bulletin has proved of such interest to Europeans that permission has been asked for its translation both into Italian and French.

#### OFFICIAL AGRICULTURAL CHEMISTS.

The cooperation of the Division with the Association of Official Agricultural Chemists has continued with mutual benefit. As a result of the systematic study of methods of investigation of soils, fertilizers, and agricultural products, the United States has now a uniform method of research, everywhere practiced and recognized as official by both trade chemists and the courts of justice. European nations have been impressed with the value of this cooperative work, and are now organizing similar associations. In view of these facts, the propriety of recognizing in some official way the Association of Official Agricultural Chemists is evident. Congress should enact some special recognition of this association, so as to establish more fully its official character and render its proceedings more valuable, not only in scientific matters, but also in the courts.

#### STREET SWEEPINGS, ETC.

The importance of disposing of street sweepings, garbage, and other refuse of cities has engaged the attention of the Division, and a considerable degree of progress was made in studying the agricultural value of these matters.

#### STUDY OF TYPICAL SOILS.

In the study of typical soils in the vegetation house it has been developed that meteoric influences other than those relating to precipitation have a great influence on crop production. The solar influences are evidently of great importance, and the distribution of solar heat is a factor not to be neglected. Excessive or deficient temperatures at critical stages of the growth of a crop are factors of prime importance in final products.

#### COOPERATIVE WORK.

The Division has been engaged in important cooperative work with the Treasury Department and other Departments of the Government. The Chemist was appointed, with my approval, by the Secretary of the Treasury, chairman of a commission charged with the work of preparing the regulations for determining the amount of duty to be collected on imported sugars. The commission also instituted a series

of investigations in the several ports of entry to investigate the manner in which the regulations were carried out. The Chemist, as a member of the international commission for unifying methods of sugar analysis, presented at the Vienna congress an important contribution in regard to this desirable agreement.

A further cooperation of the Division with the Treasury Department resulted in obtaining data in the examinations which were conducted of a character that served to save the Treasury a very large sum of money claimed as rebates under a provision of the law permitting the repayment of taxes collected on alcohol which was used in certain arts. Important cooperation of the Division was also secured in connection with the Post-Office, State, and War Departments. The Division of Chemistry holds itself in readiness to comply in the shortest possible time with all reasonable requests of the other Departments for chemical services.

#### SUGAR-BEET AND FOOD INVESTIGATIONS.

The Division continued during the year its investigations of the possibilities of producing high-grade sugar beets in various parts of the United States. As a result of the extensive chemical studies conducted, the area suitable to the production of the best beets has been more definitely delineated. A few years more of studies of this kind will mark out in a practical manner the areas where beets of the highest grade can be produced.

In the work on food adulteration interesting investigations have been instituted in the examination of food products imported from foreign countries. Critical studies of agricultural imports from the countries which exclude similar imports from our country on the ground of adulteration or unwholesomeness will be continued.

#### NEW LABORATORY.

The old quarters used by the Division of Chemistry having proved inadequate for the rapidly increasing work of the Division, a new laboratory has been leased, where more ample facilities will be afforded.

### DIVISION OF ENTOMOLOGY.

#### GENERAL INVESTIGATIONS.

General investigations have been carried on in this Division through the year upon insects injurious to garden crops, to shade trees, and to citrus trees and fruit. The general experimental work, with remedies, has comprised especially careful investigations of the availability of hydrocyanic acid gas in the disinfection of seeds in bulk and of plants and nursery material, and further experiments with arsenicals and various oil mixtures in order to determine their effects on plants in dormant condition and in foliage. One of the expert assistants of the

Division visited Europe for the purpose of studying the methods of controlling injurious insects in the Old World, with a view to determining their value and applicability to our own country, and in order to study the conditions of climate, forest growth, and method of culture in their bearing on the abundance or absence of injurious insects and the methods of prevention of insect injury.

#### SPECIFIC INVESTIGATIONS.

Specific investigations of importance may be mentioned under the following heads:

##### WORK ON INSECTS FROM ABROAD.

Careful investigation of the so-called Morelos orange fruit worm, a species which it is feared may be accidentally introduced into the orange groves of California and Florida, has been made. The distribution of this insect in Mexico was unknown even to Mexicans, and the fears of this country were considered by Mexicans to be largely imaginary. This season's investigations, however, prove that this destructive fruit worm is distributed throughout all of Mexico east of the Sierra Madre Mountains, and that it may at any time be introduced into California in early fall oranges imported from that region.

A preliminary attempt has been made to introduce from southern Europe into California an insect which is responsible for the fertilization of the Smyrna figs of commerce. The Entomologist visited California in the spring of 1898 and found that conditions were ripe for such an attempted introduction, and an agent in Europe will, during the coming year, endeavor to take the necessary steps to bring about this introduction, which, it is hoped, will result in the production by California of a fig equal to the Smyrna fig.

A successful importation has been made of an important parasite of certain large scale insects.

##### THE GIPSY MOTH.

By direction of Congress, the Entomologist made a careful study of the work which has been done by the State of Massachusetts against this imported insect pest, and has reported that after careful field study extending over practically the whole summer, he is convinced that Massachusetts is taking the proper course in making large appropriations to exterminate the insect, and that the work is being carried on in a manner worthy of all praise.

##### THE MEXICAN COTTON-BOLL WEEVIL.

The work which has been carried on during the season has developed a new and important spring remedy against this insect, and this, together with earlier results achieved by this Division, have now put Texas cotton planters into possession of a knowledge of how to

economically keep their fields free from this injurious species, which was recently thought to threaten the destruction of the entire crop of the State.

#### CHINCH BUG AND HESSIAN FLY.

During the year investigations have been made upon these two well-known and very injurious insects, and a comprehensive bulletin upon each species has been completed and is now ready for the printer.

#### OTHER INVESTIGATIONS.

Other important work carried on under this Division during the year has included the sending successfully of beneficial species to foreign Governments suffering from outbreaks of the white or fluted scale, the preparation of an account of the work accomplished during the past two years against the San Jose scale, an investigation of the injurious grasshoppers of the Western States, work upon remedies to be used against the house fly, suggested by the growing belief in the importance of this insect as a carrier of disease, work upon the geographic distribution of injurious insects of the United States, and experimental work in apiculture.

#### BIOLOGICAL SURVEY.

##### LIFE ZONES AND CROP ZONES.

With a view to determining the areas best adapted for various crops, the Biological Survey has been engaged for several years in collecting data for mapping the natural life zones of the United States. A detailed study of the distribution of the native animals and plants has been made in the belief that areas inhabited by indigenous species coincide with those most suitable for certain varieties of fruit and cereals and for breeds of domesticated animals. This investigation has now progressed far enough to permit the publication during the past year of a revised map of the life zones of the United States and two reports containing the results, of more general interest to farmers and horticulturists.

One of these reports comprised a description of the life zones and crop zones of the United States, with lists of the more important varieties of fruits and grains adapted to each area; the other an investigation of the geographic distribution of some of the more important cereals. The latter bulletin, based on reports from more than a thousand grain growers, showed the areas in which about thirty of the more important varieties of corn, wheat, and oats are now profitably cultivated, and the regions where these varieties may be expected to succeed. Field work was continued during the year in Washington, Oregon, California, Nevada, British Columbia, and northern



Mexico for the purpose of obtaining data for use in outlining the life zones with greater precision than had hitherto been possible in these regions.

#### ECONOMIC RELATIONS OF MAMMALS AND BIRDS.

The Biological Survey is often called upon to determine the value of birds and animals to practical agriculture. It is in effect a court of appeal in which complaints are investigated concerning those species which are considered injurious to crops. A careful study is made of the food of useful and injurious birds and mammals, and thousands of stomachs of birds are examined in the laboratory. Two thousand three hundred and twenty-nine stomachs, mainly of sparrows, swallows, and woodpeckers, were examined during the year. A report has been prepared on the native cuckoos and shrikes, and reports on flycatchers and native sparrows are in preparation. Several of the latter birds feed largely on weed seed during the winter, and it is a matter of no little interest to determine how far they can aid the farmer in checking the increase of noxious weeds. The importance of this work is emphasized by the increasing demand made on the Department for information and publications on birds, in consequence of the recent widespread popular interest in ornithology.

#### FUTURE WORK.

As the work of the Biological Survey becomes more generally known, the demands for information, maps, and reports increase far more rapidly than the means for meeting them. Biological maps of certain States and maps showing the distribution of particular mammals or birds are sought not only for reference but for purposes of instruction. Local biological surveys have been planned or have already been inaugurated in several of the States, and the Department has been appealed to for assistance in this work, but it has thus far been unable to actively cooperate through lack of sufficient appropriations for the purpose.

The work for the immediate future comprises a combination of field work outlining the life zones of the Pacific coast, investigations on varieties of fruits, vegetables, and field crops similar to that already undertaken in the case of cereals. An investigation which is of special interest at this time is a thorough examination of the fauna and flora of the tropical region which lies along our southern border and enters the United States at several points. Our new island possessions are entirely within this region and present an inviting field for exploration. As their resources become more generally known the question of what semitropical or tropical products can still be profitably grown in Florida and the Gulf States is likely to become a very important and practical one in several of the Southern States.

**DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.**

The work of this Division is carried on with a view of obtaining additional light on the conditions governing the growth and productiveness of cultivated plants, with special reference to diseases, nutrition, and development of new and improved sorts by breeding and selection.

**RESULTS OF INVESTIGATIONS.**

During the year valuable knowledge was obtained relative to increasing the sugar and starch-producing power of plants and the effect of soil foods on their growth and productiveness.

The study of diseases of truck and garden crops and of crops grown under glass has been continued, and methods of preventing several of the most destructive, such as black rot of the cabbage and the leaf-spot disease of melons, celery, and violets, given to growers of such crops through bulletins or by correspondence.

Smuts and rusts of cereals have received much attention. The latest and best methods of preventing smut were given to the public through a Farmers' Bulletin, and much valuable knowledge relative to rust was gained.

In the study of diseases of citrus fruits and other subtropical plants special attention was given to sooty mold and blight of the orange and blight of the pineapple.

On the Pacific coast peach-leaf curl, apple canker, a bacterial disease of English walnuts, and a new bacterial bulb disease have received especial attention. Important results have also been obtained from a study of other diseases prevalent in different parts of the country on the apple, pear, peach, plum, and other fruits, on crops of various kinds, and on forest and shade trees.

**HYBRIDIZING.**

The work of hybridizing the sweet orange with the hardy trifoliate, with a view of obtaining a variety resistant to cold, was pushed, and about one hundred and fifty hybrids obtained. In addition to this about one thousand hybrids of other citrus plants were obtained. Considerable work was done in crossing pineapples, and as a result two hundred and fifty-nine hybrid seedlings were secured. These produced plants of great vigor and confirmed the belief that by this means there may be produced fruits which will be larger, of better quality, better shippers, and more resistant to blight. Similar work was carried on with pears and with wheat and other crops.

**ROUTINE WORK.**

About six thousand letters relating to diseased plants and other lines of work were answered during the year, and about twelve thousand specimens of disease-producing fungi, representing six hundred

different species, were prepared for distribution to the experiment stations. Much time was also devoted to the preparation of bulletins and papers on results of investigations.

### SEED DISTRIBUTION.

Finding it desirable to separate the seeds to be distributed by the Department into three classes and to place the distribution of each class of seeds under the control of a Division or Section, which in a greater or less degree is interested in the character of the seeds distributed, I assigned to the Seed Division the distribution of vegetable, flower, and field seeds; to the Section of Seed and Plant Introduction the collection and distribution of foreign seeds, and to the Division of Chemistry the distribution of sugar-beet seed, the entire work of seed distribution being placed in charge of the Assistant Secretary of Agriculture.

Every effort is made to so place the seed that the best results may be obtained. Nearly all requests were complied with, none being refused when it was possible to send seed. In a number of cases special purchases of seeds not included in our contract were made for that purpose.

With few exceptions the reports from persons who have received and planted the seed have been favorable.

While it is too early to determine the value of the seeds introduced from foreign countries, I am satisfied that some varieties will prove very desirable.

The vegetable, flower, and field seeds were distributed by our contractor at Toledo, Ohio, under the supervision of the special agent and with the aid of clerical help sent from this Department.

### CONGRESSIONAL AND MISCELLANEOUS SEED DISTRIBUTION.

The seeds distributed under direction of the Seed Division during the fiscal year ending June 30, 1898, aggregated 15,702,914 papers and cloth bags, as follows: Vegetable, papers; 14,243,527; flower, papers, 1,254,037; field, papers and bags, 205,350.

Of the 15,702,914 papers and bags of seeds distributed, 13,599,586 papers and cloth sacks of vegetable and field seed were distributed to Senators, Representatives, and Delegates in Congress (by their allotments); 751,170 papers of flower and vegetable seeds to correspondents of the Division of Statistics; and 889,460 papers and bags of vegetable, flower, and field seeds to the State granges. The remainder were distributed to Weather Bureau observers, experiment stations, etc.

### DISTRIBUTION OF FOREIGN SEEDS AND PLANTS.

Prof. N. E. Hansen was appointed a special agent of the Department for the purpose of securing foreign seeds and plants valuable



for introduction into this country. Under the direction of the Section of Seed and Plant Introduction, Professor Hansen during the past year visited portions of Russia and Siberia and succeeded in collecting 57 varieties of vegetable seed, 289 of melon, 75 of fruit and berry plants, 150 ornamental plants, 70 wheat, 14 barley, 20 oats, 6 rye, 70 forage plants, 5 oil-producing plants, and a large number of miscellaneous seeds of desert plants, etc.

Upon arrival these seeds and plants were put up into about 5,000 packages by the Section of Seed and Plant Introduction and sent out largely to State agricultural experiment stations, and to such reliable cultivators as had shown a willingness to cooperate with the Department by making reports as to the success of these imported plants.

While it is too early to predict the value of most of the introductions, the most promising are a variety of alfalfa, seedlings of the Siberian apple (imported for experimenting in the Dakotas), and a new orange-fruited raspberry, and Russian sand vetch.

#### DISTRIBUTION OF SUGAR-BEET SEED.

In the distribution of sugar-beet seed they were sent to the sections that were thought best adapted to their use. The agricultural experiment stations were included in the distribution, and persons to whom sugar-beet seed were sent were advised that the State experiment stations would make analyses of the sugar beets grown in each State. Very cordial cooperation has been brought about between the Department and the State experiment stations.

The sugar-beet seed were purchased from Vilmorin, Andrieux & Co., in Paris, and from Dippe Brothers, in Quedlinburg, Germany, and distributed by the Division of Chemistry. In all, 34,436 pounds of seed were purchased, and partly distributed in bulk and partly in packages containing about 18 ounces each. Large quantities were distributed by Members of Congress, and 40 pounds of extra high-grade seed were distributed among experiment stations for use in the production of seed.

#### SECTION OF FOREIGN MARKETS.

In the Section of Foreign Markets a radical departure was made in the study of our relations with foreign markets by promptly diverting it to the field opened by the prospect of changes in Hawaii and the West Indies. The advantage of this was demonstrated by the demand for publications in that connection.

#### REPORTS ON COMMERCE OF HAWAII, SPAIN, AND PUERTO RICO.

A report on the commerce of the Hawaiian Islands was issued during the discussion of annexation. It covered the past ten years and gave special attention to trade with the United States.



When war with Spain was imminent, a rapid investigation of the extent and nature of the commerce of the people of that country was made. By quick and intelligent action information was obtained from Spanish official reports showing the foreign trade of Spain in detail, and the amount and direction of shipping under the Spanish flag. This information was made public at the critical moment, just preceding the declaration of war. It was followed a few days later by a more detailed statement of the trade between Spain and the United States.

The likelihood that Puerto Rico would become a possession of this Government called for a statement of the trade relations of that island, and it was made. Full details were presented of the exports and imports of the island. These furnished a basis for estimating its productive capacity and its requirements from other places. The statistics were from Puerto Rican official sources, and as they were made public for the first time were particularly valuable as well as timely.

#### REPORTS ON TRADE WITH AUSTRIA-HUNGARY.

Reports were issued during the year on the foreign trade of the United States in agricultural products and on the wheat production of Austria-Hungary. In the first of these the classification of agricultural imports and exports was carefully revised and a comprehensive and instructive presentation of the important facts was made. The demand for the report on foreign trade in agricultural products was so strong that the essential information was embodied in a circular, of which 85,000 copies were distributed.

In compliance with a request from the Secretary of State, much time was devoted to the compilation of information for the use of the special commissioner appointed to negotiate reciprocity treaties.

#### OFFICE OF ROAD INQUIRY.

##### EFFORTS FOR GOOD ROADS.

The problem of securing good roads continues to be a very important branch of work. Publications upon the subject of the best methods for road improvement have been distributed freely. Care has been taken to send them where they would be most effective in stimulating activity in the movement. Representatives of the Office have attended many important meetings for the discussion of roads, and in this way valuable information has been both gathered and disseminated.

In localities where construction of roads according to the most approved methods has been in progress a representative of the Department has made a study of the operations and extended such assistance as was possible. The Office of Road Inquiry has also actively cooperated with two of the State agricultural experiment

stations in spreading the work of good roads. The road laws of several of the most progressive States have been collected and studied.

These efforts have met with hearty appreciation in every direction, and there has been a steady increase in the demand for assistance. Both country papers and the metropolitan dailies have become interested in the movement and have printed very much upon the subject, in many instances reproducing Department circulars and bulletins in full.

#### OBJECT-LESSON ROADS.

The object-lesson road at the Rhode Island Agricultural College has been completed, and a report of the details of the work, along with the results of other inquiries, will be presented in the Yearbook for 1898. Owing to lack of funds it has been impossible to comply with calls for similar aid elsewhere, and it has been necessary to discontinue these object lessons in connection with agricultural colleges and experiment stations, although many of these institutions are still calling for aid. They are ready to bear most of the expense, asking of the Department only the payment of freight on machinery and of part of the salaries of experts. The help given from this Department usually proves sufficient to secure the financial support of the towns and farming communities in the vicinity of the experiment. Numerous letters received by the Office of Road Inquiry testify to the great value of these cooperative experiments. Everywhere the plan meets with the highest commendation, but it can not be extended without an additional appropriation.

#### STEEL ROADS.

The aim of the Office of Road Inquiry is to cooperate with people of the several States in making the best possible use of material within their reach in road making. Large areas in many of the States have no gravel, rock, or other hard material with which to make roads. I have had experiments made during the present year with steel as extensively as our means would permit.

An experiment of this kind is being conducted at Cleveland, Ohio. A section of 500 feet of steel track has been laid on a street in the suburbs where the traffic is heavy, and its value is already generally acknowledged. A sample steel road 510 feet long has been laid upon the grounds of the exposition at Omaha. It is proposed to make traction tests upon this track to show how much less power is required to move a load over such a road.

The steel road is not excessively costly by comparison with other roads and will last much longer with less repair, and is probably the most economic road for localities where material is not obtainable for macadamizing.

## SENTIMENT IN FAVOR OF GOOD ROADS.

The growth of sentiment in favor of good roads is shown by the passage of progressive laws in New York, Pennsylvania, and other States, and by the appointment of a highway commission in Maryland, and also by the reports of increased sales of road-making machinery.

## DIVISION OF AGROSTOLOGY.

## EXPERIMENTS IN THE GRASS GARDENS.

Through the efforts of this Division we are learning the needs of the several sections of the country and the forage problems which they have to meet. We are acquiring a better knowledge of the distribution and value of our native grasses and forage plants, as well as the peculiar conditions of soil and climate best suited to their growth. More than 500 varieties of grasses and forage plants valued for forage have been grown in the grass garden on the grounds of the Department during the past season. Visitors from all parts of the country have been much interested in this exhibition, which has afforded many lessons, not only of interest but of real practical value.

The garden contains plats of grasses suitable for lawns, besides many species from the East and from the South, and especially from the West, all growing together with apparent success, and it is interesting to note the peculiar habits of the grasses of the moist and wooded regions of the East and those of the arid, treeless regions of the West as here displayed. A large number of leguminous plants have been given a place in the garden, and one of the most interesting experiments has been a trial of alfalfa grown from seed obtained from more than twenty different sources. Trial samples of these seeds were sent to a large number of experiment stations who volunteered to undertake comparative experiments in their cultivation. Up to the present time it has not been possible to detect any marked variation in the plants grown. Turkestan alfalfa, the seed of which was introduced last year in large quantities from Russia, has made a remarkable growth in some of the experiments conducted in the West. At North Yakima, Wash., it made a growth of over 3 feet in seventy-nine days, sending up many stems from each root. It is believed that this alfalfa will prove to be more hardy than the ordinary sort, and it may be distinguished by minute hairiness on the under surface of the leaves.

Many varieties of grasses and forage plants have been tested at the grass garden at Knoxville, Tenn., during the year. It has, however, been thought best to discontinue official connection with this garden and select a station farther south, which shall be more typically Southern in its character, both in soil and climate. The problem in Tennessee is not so much what can be grown as how to grow the



largest amount of the best quality with the least expense, problems which the agricultural experiment station at Knoxville is now well prepared to solve.

#### INVESTIGATIONS FOR THE IMPROVEMENT OF FORAGE RESOURCES.

In connection with the investigations in the Southwest two stations have been established—one at Abilene and one at Channing—the former presenting conditions characteristic of the center of Texas and the latter of the great region of northwest Texas, known as the Panhandle. The experiments carried on at these stations were made with a view of determining how the cattle ranges may be improved by practical methods. At the station at Abilene more special lines of investigations and experiments are being carried on, especially in the way of testing varieties which may be suited to that region.

Comparative work of the Division is being performed by many volunteer experimenters, especially among the more intelligent farmers in Colorado, Texas, Wyoming, Montana, and Idaho. The object of these experiments is the introduction of new or little-known and desirable hay and pasture grasses, as well as soiling crops. A number of the more progressive ranchmen and stockmen of the Northwest have agreed to devote from 1 to 5 acres of cultivated land to the more promising native grasses or those introduced from foreign countries, seed of which we may be able to furnish them.

Seeds of grasses and alfalfa imported from Russian and eastern Asia were sent in amounts sufficient to sow from one-twentieth of an acre to an acre of each variety to 479 parties who had previously agreed to give them careful cultivation and report fully at the close of the season the results obtained. The data thus secured can not fail to be of great interest and value to all interested in the improvement of the forage resources of our country. Eleven hundred packages of seeds of native grasses, salt bushes, wild clovers, wild beans, and lawn grasses, mostly collected by the employees of the Division while in the field, were distributed to our correspondents, who expressed a desire to aid the Division in its investigations.

Field investigations in the States along the Gulf coast have been carried on during the past two seasons and one report upon the work done in this section is now in the hands of the printer. Work, as already indicated, has been carried on in the Southwest, and in the Northwest investigations have been made by special agents, whose reports have already been published.

The field work so far has been confined to the Atlantic slope, but there is being manifested among the farmers and ranchmen of the Pacific coast a marked interest in grass and forage-plant questions, and a demand for an extension of our work along these lines in the States west of the Divide is now being made.

## THE GRASS COLLECTION.

Over 5,000 specimens of American grasses have been identified during the year and nearly 3,000 sheets of herbarium specimens mounted and added to the National Herbarium. The grass collection now in the Department numbers over 30,000 sheets.

## DIVISION OF SOILS.

The Division of Soils has continued the investigation of the physical properties of soils and their relation to crop production, and work has now been started upon the mapping of soils on a scale of  $\frac{1}{4}$  inches to the mile, to be published probably on a scale of 2 inches to the mile. These maps will show in great detail the soil areas adapted to the different agricultural crops. Considerable advance has also been made in devising methods of investigating soil conditions where crops suffer, or where the soil conditions are not well adapted to crops which the location and markets demand.

## RECORDS OF MOISTURE CONTENT OF SOILS.

Records have been continued of the moisture content of some of the principal soil areas in the country with the electrical method of moisture determination. As the soil is the immediate source of the water supply of plants, this record becomes an essential part of climatology, and it seems probable that this work of the Division of Soils, in connection with the present work of the Weather Bureau and of the Division of Statistics, will develop a distinctively new line of agricultural climatology. This work is closely related to the work of the Weather Bureau, but is supplementary to it. It includes the record of evaporation to which the plant is subjected, the water supply maintained by the soil for supplying the loss due to this evaporation, and the intensity of the actinic and heat radiations which influence the physiological activities of the plant. Numerical values can be given to the evaporation and to the soil-moisture conditions, so that it is possible to express numerically the relative conditions of plant growth from day to day so far as these two important factors of evaporation and water supply are concerned. This will add greatly to the practical value of our knowledge of climatology.

## INVESTIGATION OF ALKALI SOILS OF YELLOWSTONE VALLEY.

The electrical method of salt determination in soils has been used in the exploration and investigation of the alkali soils of the Yellowstone Valley. An examination was first made of the general conditions in the valley, and then a very minute study of a section of land which was just being ruined by the rise of alkali. This examination amounted to an underground survey of the field, and maps have been

made showing the distribution of alkali at different depths. A great number of borings were made to a depth of 10 or 15 feet, and salt determinations were made in every 6 inches or each foot in depth. Accurate maps have been made showing the amount and distribution of the alkali at several of these depths.

The result of this investigation will be issued in the form of a bulletin. Briefly, it was found that in the original prairie soil above the ditch there is not sufficient alkali to be injurious to vegetation. The amount of alkali was greater in the lower depths of the subsoil. As a rule, water is used in excess on all of these lands under irrigation, and to such an extent that it accumulates in the subsoil. When the depth to standing water is not more than 2 feet from the surface, alfalfa turns yellow and dies out. In all cases the first injury was from the accumulation of water from excessive applications through irrigation. Where this water remains for some time in the subsoil the alkali leaches down through seepage from higher lands, and is brought up from the subsoil and accumulates at the surface in quantities sufficient to prevent the growth of cultivated plants. Other problems of great value to the agriculturist were worked out in the course of this investigation. Such work will be invaluable in the treatment of alkali soils.

This underground survey of the alkali lands has given the most important information in regard to the amount and distribution of the soluble salts and the way in which they accumulate in certain localities through overirrigation.

#### TOBACCO INVESTIGATIONS.

The tobacco business has become very highly specialized. Each market has its own requirements, each class of users has its own particular style, and each season brings some change of style which must be met by the tobacco grower. There is a great deal of competition in our own country and very serious competition from abroad, especially from Cuba and Sumatra. In several of our tobacco districts the acreage has been reduced one-half in the past ten or fifteen years. Some of the districts have almost completely abandoned the culture of tobacco. On the other hand, several new localities are being opened, with prospects of good prices for the better grades of wrapper leaf both for cigar and manufacturing purposes. The best we can do, however, in the cigar leaf is far below the product of foreign countries. The Cuban filler sells for ten times as much as the Pennsylvania and Ohio filler; the Sumatra wrapper is worth ten or fifteen times as much in the markets as the Connecticut wrapper. To meet this competition it is absolutely necessary that our farmers should have at their disposal a thorough knowledge of their own conditions and of the conditions of the soil, climate, methods, and labor conditions of competing districts.



## SOIL MAPS OF THE TOBACCO DISTRICTS.

One of the first necessities in the development of a new district or in the improvement of an established district is an accurate soil map of the locality, on which the soils adapted to the different types and grades of tobacco are plainly shown. In all of our tobacco districts there are large areas of land sown to this crop which are not adapted to a good grade of tobacco. There are also large areas well adapted to a fine grade of leaf which have never been used for this purpose. Enough is known of the relation of soils to tobacco to warrant the preparation of very accurate maps, indicating the character of the tobacco from each of the soil areas in the district. After these types have been established and the soil areas have been mapped, the experiment stations can take up a study of the cultural methods adapted to each of the types of soil. In this study of the influence of the soil upon the quality of the leaf it is important to extend the study to all localities, and to gather information from Cuba and Sumatra as well as from Kentucky, Virginia, Pennsylvania, and Connecticut. This is work that the experiment stations can not do for themselves.

## CURING AND FERMENTATION.

Among the most important lines of work which the Department can take up for the tobacco grower is the study of the diseases in the tobacco bed and the comparatively few diseases in the field, and particularly the study of curing and fermentation. A large amount of research work has been done, particularly in Germany, in the fermentation of tobacco, but very little is yet known of the changes which go on in the process or regarding the specific agents which bring about these changes. So much information and practical benefit have been derived from a study of butter and cheese, in the control of the ferments and bacteria which produce the texture and flavor of the product, that it is very desirable that similar knowledge in the curing and fermentation of tobacco and similar control of the finished product should be secured. This work will require very careful study of the changes in the fermentation pile in the different tobacco districts.

It is important to know exactly to what organisms the peculiar flavor and aroma of the tobacco is due; what influence is exerted by the character of the leaf, by climatic conditions, and by methods of manipulation. This work can only be thoroughly done by systematic working in different tobacco districts in our country with different varieties of tobacco and different climatic conditions. It should certainly embrace a study of fermentation in the tobacco of Cuba and of Sumatra. If our tobacco growers are to attempt to raise a product equal to that of Cuba and Sumatra, and if this is to be done not by chance, but through systematic, scientific investigations, then the soils

and other conditions of growth must be thoroughly understood and the fermentation changes carefully worked out in Cuba and Sumatra. It is necessary, therefore, that a soil expert and a bacteriologist extend their work to these foreign countries.

In view of the great importance of the tobacco industry in this country and of the very important practical results which are likely to accrue from the investigation of the subjects herewith presented, I have submitted in my estimates to Congress a special appropriation for tobacco investigations.

### DIVISION OF FORESTRY.

#### CHANGE IN CHIEF OF DIVISION.

At the end of the fiscal year the creation of the New York State College of Forestry and the election of Mr. B. E. Fernow to the directorship created a vacancy in the position of Chief of the Division, which Mr. Fernow held for twelve years, and Mr. Gifford Pinchot, of New York, was appointed his successor.

#### TREE PLANTING IN THE TREELESS REGIONS.

Believing that the attention of this Division should be directed rather more to the tree-planting interests of the treeless regions, I directed the discontinuance of the series of investigations which had in view a better knowledge and use of our economic timbers, in order that the funds might become available in the aforesaid direction. The forest-planting experiments in cooperation with the State agricultural experiment stations were, therefore, prosecuted more vigorously and extended to Texas, Oklahoma, and Montana, besides adding another station in Pennsylvania, where the methods of reclothing cut-over lands were to be demonstrated.

By my direction a plan was elaborated for the introduction of species adapted to dry climates and a competent agent appointed to carry out the plan, which contemplates the establishment of a number of arboreta in our dry regions, in which are to be assembled such trees and shrubs from all parts of the world as might eventually prove adapted to these regions. One of the most useful lines of work has been a canvass of the forest conditions of the State of Wisconsin, in cooperation with the State geological survey, which has brought out the significant fact that, through careless lumbering, followed by destructive fires, over 8,000,000 acres of that State have been rendered practically useless and one-half that area a veritable desert as far as present economic conditions are considered.

#### TIMBER PHYSICS INVESTIGATIONS.

The accumulated data of the investigations in timber physics have been worked over in part and yielded some most important results,

among which the law that the strength of a beam at the elastic limit is equal to the compression strength of the material, which was established by the tests of the Division, will influence the practice in the use of wood for construction most advantageously.

#### PLANS FOR THE COMING YEAR.

The plans for the Division of Forestry, approved by me, for the coming year cover the following lines of work, all of which are directly related to the welfare of our people:

Practical assistance to farmers, lumbermen, and others in handling private forest lands. Since these lands exceed by far in area those of the Government and the States combined, woodland in farms alone covering more than 200,000,000 acres, this attempt to increase their present as well as their future value, and thus secure their preservation, has before it a field of wide usefulness.

An attempt to find the best trees for planting in the so-called treeless regions of the West, a matter of far-reaching importance to a very large percentage of the farming population of this country.

A study of the history, nature, and ways of action of forest fires in the United States and their effect on the composition and reproduction of forests. The prime object of this work, which covers a field practically untouched until now, is to develop better methods of preventing and extinguishing these fires than have yet been employed.

A study of the effect of lumbering on the forests, in order to devise improved methods advantageous both to the lumberman and to the forest. Combined with this work, detailed investigations of the growth of trees of special commercial importance will be made, with the object of ascertaining whether and how much it will pay to hold timber land for future crops.

Investigation of the timber resources and requirements of Alaska, Cuba, and Puerto Rico, which is needed to meet the numerous requests for information made to this Department.

In addition, a classified series of forest photographs, intended to furnish illustrations of the results of the various lines of work, will be begun during the year.

The extremely practical character of these lines of work is evident. Their popular standing is indicated by the fact that the assistance of the Division has been asked in the handling of nearly a million acres of forest land, under an arrangement by which, in the case of all but farmers' wood lots, the Department is relieved of all expenses, except salaries, for its agents in the field.

In view of these facts I have been impelled to lay before Congress the urgent need of a considerable addition to the appropriations at my disposal for the use of the Division of Forestry.



**OFFICE OF EXPERIMENT STATIONS.****THE STATE EXPERIMENT STATIONS.**

The examination of the work and expenditures of the agricultural experiment stations by the Office of Experiment Stations during the past year has shown that these institutions are, as a rule, working more thoroughly and efficiently than ever before for the benefit of American agriculture. More than six hundred persons are employed in the work of administration and inquiry. About four hundred reports and bulletins were issued by the stations in 1897, which were directly distributed to over half a million addresses, besides being widely reproduced in the agricultural and county papers. The appropriation of \$720,000 from the National Treasury for the support of the stations was supplemented by State funds aggregating over \$400,000.

The need and value of scientific researches on behalf of agriculture are now very clearly understood, and the number and importance of institutions organized for this work are constantly increasing in all parts of the world. Nowhere has so comprehensive and efficient a system of experiment stations been established as in the United States. In the scope and amount of their operations, and in the thoroughness with which the useful information they obtain is disseminated among the farmers, our stations are unsurpassed. During the ten years which have elapsed since the Hatch Act went into effect a very large amount of accurate information of direct practical benefit to our farmers has been published by the stations. Not only have the numerous bulletins and reports of the stations been freely distributed in all parts of the country, but many valuable books largely based on the work of the stations have been written for the farmers' use, while the agricultural press has busily collated and disseminated a vast mass of information directly relating to the work of the stations or supplementary to it. The contrast between the correct information regarding the principles and practices of his art easily obtainable by the farmer of to-day and that available for his predecessor of a generation ago is very wide and striking.

**NEED OF MAKING OUR STATIONS STILL MORE EFFECTIVE.**

The general success of our agricultural experiment stations makes it all the more important that they should everywhere be organized and conducted with a view to securing the most economical and efficient service for the benefit of agriculture. It were well if the farmers in every State and Territory were alive to the importance of making each and every experiment station a thoroughly effective institution for agricultural research. There are certain principles which experience has shown must be followed in the management of stations if they are to be most highly useful. Attention has been called to these from

time to time in the reports of the Department, but there is still need to urge upon appointing officers, governing boards, and all the friends of agricultural progress that, in order to make the experiment stations what they ought to be, they must be organized on a permanent basis, and their plans of work must be carefully made and carried out by thoroughly trained experts, who are so circumstanced that they can give time and energy in full measure to the research work.

Political considerations should have no place in the choice and retention of station officers, college duties should not be allowed to encroach on the time set apart for original investigation, and the compilation of old information should always be made secondary to the acquirement of new knowledge. Our farmers are worthy of the best that science and expert skill can win for them out of the realm of the facts and principles which nature will reveal to the diligent student of her mysteries. To divert from their highest and best uses any of the funds which the people have freely given to bring the aid of science to agriculture is most reprehensible. The stations which are held in the highest honor alike by scientists and farmers are those in which there has been most original and thorough work.

The stations are not the only means for the education of the farmer. Agricultural colleges, farmers' institutes, boards of agriculture, and various other agencies have been established to instruct the farmer regarding the present status of agricultural science as applied to his art. It is the business of the experiment stations, on the other hand, to advance knowledge of the facts and principles underlying successful agriculture and to teach the farmer new truths made known by their investigations. The act of Congress creating the stations clearly defines their functions to be the making and publishing of original investigations. Wherever a station has neglected this and merely endeavored to educate the farmer, we find a weak station, and wherever a station has earnestly devoted itself to original investigations, we find a strong station. The station may very properly lend its influence to strengthening the influence and work of the educational agencies established for the farmers' benefit, but it fails to fulfill its real mission when it resolves itself into a bureau of information or devotes a large share of its energies to the compilation of popular treatises on agriculture. It is gratifying to observe that the original investigations at our stations are increasing in number and improving in quality. In some places, however, there is still need of decided changes in policy and work.

#### WORK OF THE OFFICE.

In connection with its supervision of the expenditures of the experiment stations, representatives of this Office have visited the stations in all the States and Territories. During the year the Office issued 43 documents, among which were included the ninth volume of the



Experiment Station Record, 12 bulletins, and 7 Farmers' Bulletins. The review of the literature of agricultural science in the Experiment Station Record has been made more complete than heretofore, and embraces all the countries in which agricultural investigations are conducted. No such comprehensive survey of this field of scientific research is made elsewhere. With the aid of the Record our investigators are kept well informed regarding the progress of agricultural science throughout the world.

In accordance with my instructions the Office has systematically engaged in the preparation of popular résumés of the work of the experiment stations for publication as Farmers' Bulletins. Several of the bulletins have been issued and are grouped together in a sub-series denominated Experiment Station Work. Each of these bulletins contains a number of short articles, summarizing the results of recent investigations in different lines, and explanations of the technical terms necessarily employed in describing the results of investigations. As stated in a prefatory note in each number, "the chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations and thus to acquaint our farmers in a general way with the progress of agricultural investigation on its practical side." One of the chief reasons for establishing an Office of Experiment Stations in the Department was that it would be able to collate and disseminate the information obtained by the individual stations for the benefit of farmers throughout the country. It is believed that this new series of popular bulletins makes the work of the Office much more effective in this direction. Now that the purpose of these bulletins is being understood there is a large demand for them.

The Office has somewhat extended its work in collating and publishing information regarding the agricultural colleges, and in promoting the general interests of their work. It has also continued in charge of special agricultural investigations in Alaska and of the researches on the food and nutrition of man which the Department is conducting in cooperation with colleges and experimental stations. Investigations on irrigation, to be carried on in a similar way, have recently been intrusted to this Office.

#### AGRICULTURAL EDUCATION.

The past year has been marked by considerable progress in the more complete organization of courses of instruction in agriculture in our colleges and universities. The general subject of agriculture is being divided in these courses with a view to securing more efficient teaching in the several branches. Instead of having one professor of agriculture as in the past, a number of our colleges have separate chairs of plant production, animal husbandry, and dairying. Departments of soil physics with separate laboratories are being established.

The buildings, apparatus, and other facilities for agricultural education have been materially improved during the year. The improvement in the equipment and methods of instruction has resulted in bringing more and better students into the agricultural colleges.

The movement for the extension and popularization of agricultural instruction is growing in importance. The short and special courses in the colleges, the farmers' institutes, and the home-reading circles are attracting larger numbers of farmer students. The effort to introduce nature teaching, largely on subjects relating to agriculture, is being actively prosecuted in several States. The time seems ripe for the introduction of outline courses in the theory and practice of agriculture into the secondary schools in or near our rural communities in much the same way that business courses are employed in the city high schools.

There is a growing demand that this Department shall furnish our people with information regarding the progress of agricultural education at home and abroad. The necessity for the more careful study of the problems of education as related to the progress of our country in agriculture, as in the other arts and industries, is being forced home upon us by the closer relations of the United States with the rest of the world which recent events have done so much to promote. The Department of Agriculture, sustaining close relations with the workers on the farms and the educational institutions already established for their benefit, might accomplish much more toward the improvement and wide extension of agricultural education. I have therefore recommended a small increase in the appropriation for the Office of Experiment Stations to enable it to extend its work in this direction.

#### AGRICULTURAL INVESTIGATIONS IN ALASKA.

The first appropriation "to enable the Secretary of Agriculture to investigate and report to Congress upon the agricultural resources of Alaska, with special reference to the desirability and feasibility of the establishment of agricultural experiment stations in said Territory," became available July 1, 1897. The general supervision of the work under this appropriation was assigned to the Director of the Office of Experiment Stations. Special commissioners were appointed to visit the coast and island region of Alaska, and by the courtesy of the honorable Secretary of the Interior the superintendent of Government schools in Alaska collected information regarding the agricultural capabilities of the Yukon Valley. Collections were made of soils and of native plants, especially those used for food and forage. Data were obtained regarding the general topography, climate, and soils; natural and cultivated products and methods of cultivation; stock raising; area of arable lands; agricultural difficulties and possibilities; desirability of experiment stations, and the locations suitable for them.

Specimens of vegetables and small fruits, in no way inferior to those grown elsewhere in the United States, were collected in different parts of Alaska, and analysis of the grasses which grew very luxuriantly in many localities in that region showed them to be fully as nutritious as those produced in the most favored agricultural regions of this country. The reports of our agents, prepared under the direction of the Director of the Office of Experiment Stations, were transmitted to Congress last December and were published as Document No. 160 of the House of Representatives, Fifty-fifth Congress, second session, and afterwards as Bulletin No. 48 of the Office of Experiment Stations.

In accordance with my recommendation, Congress continued the appropriation for work in Alaska during the current fiscal year, increasing the amount to \$10,000. Prof. C. C. Georgeson, a native of Denmark, and thoroughly familiar with the conditions of agriculture in northern Europe, who had had a long experience as professor of agriculture and an experiment-station officer in Japan and Kansas, was transferred from the Division of Agrostology to the Office of Experiment Stations and made special agent in charge of the Alaska investigations. He has made his headquarters at Sitka, in the vicinity of which place experimental plantings of seed of over 100 varieties of vegetables, grasses, and forage plants have been made.

Seeds have also been distributed to a number of different localities in Alaska, and agreements for cooperative experiments in a number of places have also been made. The building of a silo for the preservation of native grasses and the feeding of the silage to horses and cattle have been arranged for on a farm in the vicinity of Juneau. After careful examination Castle Hill, a lot in Sitka, which a number of years ago was set aside as a site for Government buildings, which were afterwards located elsewhere, has been reserved by an order of the President as a proper place on which to erect a building to serve as headquarters for the experiment station and weather service in Alaska. About 110 acres of partly cleared land have also been reserved in the immediate vicinity of Sitka for experimental purposes. A similar reservation has been made on Kadiak Island, and it is proposed to make a third reservation on the Kenai peninsula.

The botanist of the Office of Experiment Stations has continued the botanical survey of the region in the vicinity of Sitka and Cook Inlet begun last year.

The reports of the officers engaged in the Alaskan investigations during the present season have not yet been prepared, but it is expected that they will be ready for transmission to Congress early in its coming session. Enough has, however, been done to show that it is both desirable and feasible to carry on agricultural investigations in Alaska. To accomplish results of any value it will, of course, be necessary to plan these investigations to cover a series of years, and comparatively little of practical importance can be expected from



them until they have been in progress for some time. The experiments and observations made in the field should be supplemented by work in the laboratory. No provision has thus far been made for the erection of such buildings as will be needed in connection with these experimental investigations. It is also very desirable that experiments with live stock should be undertaken in the near future. The appropriation for these investigations should also be made with reference to the difficult conditions under which the work must be prosecuted. I therefore urge that the recommendation of the Director of the Office of Experiment Stations, that the appropriations for Alaska investigations for the ensuing year be the same in amount as that for experiment stations in other parts of the United States, be adopted in the appropriation bill for the next fiscal year. As it will be very desirable to enlarge our experimental operations in Alaska at the outset of the season of plant growth, commencing with the spring of 1899, I hope that the next appropriation for this work will be made immediately available.

#### NUTRITION INVESTIGATIONS.

The investigations upon the "nutritive value of various articles and commodities used for human food" have been pursued as hitherto, in cooperation with agricultural colleges and experiment stations and other educational institutions. In this way the Department has secured the services of experts and facilities for its work on very advantageous terms. There have been many indications that public interest in these inquiries is widespread. Special investigations with the respiration calorimeter have been made, in which not only the nutritive value of the food consumed but also its relation to the heat and energy evolved by the human body during periods of rest and work have been measured with a completeness and accuracy hitherto unknown. These investigations are not only of very high scientific importance, but have also already given promise of useful practical application. The results of the careful studies of the dietaries of people of different occupations, made in connection with the nutrition investigations, have been widely republished in this country and abroad.

It is believed that the nutrition investigations of the Department have already done much to establish a scientific basis for the courses of instruction on the food and nutrition of man, which are rapidly increasing in number and importance throughout the country. The amount of information which the Department has published in connection with these investigations has already been relatively large, and the accumulation of unpublished data will make it possible to publish a number of bulletins on this subject during the present fiscal year.

## IRRIGATION INVESTIGATIONS.

The friends of the development of irrigation as applied in agriculture in the vast region west of the Missouri River secured from Congress at its last session an appropriation of \$10,000 for the current fiscal year, to be expended under the direction of the Secretary of Agriculture "for the purpose of collecting from agricultural colleges, agricultural experiment stations, and other sources, including the employment of practical agents, valuable information and data on the subject of irrigation, and publishing the same in bulletin form."

With a view to securing economy in the general administration of this fund it was decided not to create a separate division for this work. As by the terms of the act the work was largely to be done in cooperation with the agricultural colleges and experiment stations, its general supervision was intrusted to the Director of the Office of Experiment Stations. Special effort has been made to secure the services of experts who have had not only scientific training but also practical experience in irrigation as conducted in the Great West. With a view to formulating plans of work along the most useful lines, a conference of experiment station officers and irrigation engineers was held at Denver last summer under the direction of the Director of the Office of Experiment Stations. The problems of irrigation were earnestly and freely discussed at this conference and the needs of the farmer for information on irrigation subjects were carefully considered. As a result of the expert advice which the Department thus received, it has been determined to confine the work on irrigation at present to two general lines: (1) The collation and publication of information regarding the laws and institutions of the irrigated region in their relation to agriculture, and (2) the publication of available information regarding the use of irrigation waters in agriculture, as determined by actual experience of farmers and experimental investigations, and the encouragement of further investigations in this line by the experiment stations.

Arrangements have already been made for the preparation of several bulletins by competent experts, and it is hoped that during the present fiscal year considerable useful information will be published and distributed by the Department. It is obvious that the present appropriation will enable the Department to go only a little way in the accomplishment of the work which is urgently demanded by the growing agricultural interests of the irrigated region. I heartily concur with the opinion set forth in the report of the Director of the Office of Experiment Stations, that Congress should establish a settled policy regarding the work of this Department on irrigation, and that if it is deemed wise to continue such work under my direction appropriations shall be made which will enable the Department to plan irrigation investigations on a comparatively large scale and continue



them through a series of years. Some of the reasons which seem to make it very desirable that investigations on irrigation should be systematically pursued by this Department are set forth in the report above referred to, and I ask that careful consideration be given to the arguments there made in support of this proposition.

It is clear that a crisis has been reached in the life of the communities in which agriculture is dependent upon irrigation for its success. The laws and institutions relating to irrigation, which have grown up in these communities, have in many ways proved so inadequate and unsatisfactory that there is a widespread feeling that radical and immediate action is demanded for their reformation. Unfortunately, the accurate information on which alone intelligent reforms can be based is almost wholly lacking. As the problems which confront these communities are, in a general way, the same, and in many particulars affect the national as well as local interests, it is highly appropriate that the National Government should undertake investigations to aid in the solution of the problems of irrigation. As many of these problems are directly connected with those in other agricultural lines in which this Department and the experiment stations are working, it is my judgment that this Department should be put in a position to efficiently organize and conduct important investigations in this line.

As already stated, the investigations of the Department may properly follow two general lines: First, a careful study should be made of the laws and institutions of the irrigated region with special reference to their improvement. The objects of this work will be (1) to aid courts and administrative officers in the adjudication of claims respecting water rights; (2) to bring out the defects in existing laws and methods of administration, and to furnish impartial and adequate information on which wiser and more equitable legislation and court decisions may be based; and (3), to assist farmers in the acquirement of water rights and to protect their interests in the appropriation and use of water for irrigation. The other branch of work which the Department should take up is the carrying on of thorough original investigations along a number of different lines. The agricultural experiment stations in the irrigated regions have already shown the way in which such investigations should be conducted. Their means have, however, been too limited to enable them to make more than a beginning of the work in this direction.

One fundamental investigation which should be immediately undertaken relates to the correct determination of the practice of successful farmers in the use of water for irrigation with different soils and crops. At present such information is almost wholly lacking. The collation of such information in sufficient amount to warrant the conclusions on which agricultural practices, laws, and judicial and administrative proceedings may properly be based is in itself a large task.

The data thus obtained would be of great value, not only for practical purposes, but also as a guide to investigations by the experiment stations and other agencies. When once the actual amounts of water used by farmers in the irrigated regions have been determined, investigations should be undertaken to find out what is the minimum of water required by different soils and crops, in order that we may know to what extent the available water supply of the irrigated region may be utilized in the development of its agriculture. There are numerous other irrigation investigations which the Department and the experiment stations might well undertake; such are those which relate to the most economical methods for the application of water to crops, the utilization of the rainfall as affecting the need for irrigation waters, the problems of seepage and drainage, the effect of irrigation water on the growth and productivity of plants of different kinds, the prevention of the accumulation of alkali in the surface soils, and the reclamation of the alkali lands.

I believe that the importance and variety of the work demanded in the interests of irrigation in this country will justify a large increase in the appropriation for irrigation investigations by the Department. I hope that at the coming session of Congress a well-defined policy regarding the work of the Department on this subject will be definitely adopted.

#### DIVISION OF BOTANY.

##### SHEEP GRAZING IN THE FOREST RESERVES.

At the request of the Secretary of the Interior, the Botanist of the Department was directed early in July, 1897, to proceed to the Cascade Forest Reserve of Oregon to investigate and report upon the effect of sheep grazing on the forests of that region, an agricultural investigation for which his long experience in Western botanical exploration had well equipped him. The report demonstrates that the old system of unrestricted use of the forest lands as a grazing common is a public evil and is a menace to other branches of agricultural and State prosperity. A feasible way of removing this menace is conclusively pointed out, and fortunately the method proposed not only is not antagonistic to the interests of those engaged in stock grazing, but is distinctly favorable to them. The adoption of the proposed system gives every promise of contributing materially to the solidity of agricultural institutions in the West, more especially to the range-stock industry itself.

##### CHICORY GROWING, ETC.

In my last Annual Report attention was called to the fact that the United States imports annually at least \$8,000,000 worth of minor agricultural products, nearly all of which could undoubtedly be grown with profit by the farmers of this country. The first of these crops

taken up for investigation was chicory. Following the Department's support of the chicory-growing industry, which consisted, first, in indorsing a tariff of 1 cent per pound on imports of the crude root, and secondly, in publishing, after a careful investigation, a full report on the methods of chicory growing, the imports of chicory, which in the fiscal year 1896 amounted to 16,317,888 pounds, and in 1897 to 17,329,170 pounds, dropped in the fiscal year 1898 to the astonishing total of 315,707 (raw) pounds. Making due allowance for the heavy antetariff imports of May and June, 1897, it is clear that a very large percentage of the chicory consumed in the United States during the last fiscal year was grown by American farmers. Not only does this result appear from the import statistics just cited, but the Department has direct information of the establishment and successful operation of chicory farms in Michigan, Nebraska, and other States. In several respects methods of chicory growing as now practiced in the United States are superior to the Belgian methods in the substitution of horsepower for hand cultivation, the use of superior plows, new and much cheaper method of digging the root, and more efficient slicing and evaporating machinery.

Investigations of other miscellaneous agricultural imports of the United States are now under way.

#### SEED TESTING.

To the Division of Botany has been intrusted the task of testing all the seeds sent out by the Department, not only those of the regular departmental distribution, but those imported through the recently established Section of Seed and Plant Introduction and those procured in other ways for the experimental work of the various Divisions. Never before has the Department distributed seeds of higher purity and germinative capacity than during the past year. Furthermore, an elaborate series of field tests was made to ascertain whether the seeds were really of the varieties stipulated in the contract. It was found that in several cases the varieties were wholly at variance with the contract, seeds of cheaper varieties having been substituted, presumably by the subcontractors. The fact that these varieties were not true to name could not, of course, be ascertained for several months after the seeds were distributed, but a portion of the purchase money was withheld, pending the result of the field tests, and a commensurate reduction was made in the price paid for the seed. The principal beneficial result of this action is expected to lie in its warning to future contractors that they will be paid for no inferior seed, whether this inferiority is due to themselves or to their subcontractors.

The seeds purchased in Russia by Prof. N. E. Hansen, special agent of the Department, for introduction into the United States, upon their receipt in Washington were found to contain a large amount of weed seed, in many cases of kinds not yet known in the United States.



On account of the lack of seed-cleaning machinery in the districts in which the seed was purchased it was impossible to get clean seed. Every package, therefore, was carefully tested in Washington City for purity, and if found to contain weed seeds was carefully cleaned, either by machinery or by hand. Furthermore, the seeds when distributed were accompanied by a memorandum calling attention to the danger from foreign weeds and directing their extermination, should any appear.

#### GINSENG.

The efforts of the Department in encouraging the cultivation of ginseng have met with gratifying success. An investigation of the subject was begun in 1893 and a report issued in the following year. At that time the Department announced the cultivation of the root as feasible, but could of course give no information as to the manner in which cultivated root would be received in the Chinese market. During the past four years, however, experimentation in ginseng culture has gone steadily on. The cultivated product has been marketed, and the commercial status of cultivated American ginseng established. First-class cultivated roots, dried, have been selling during the past year at \$5.50 to \$6 per pound, slightly in advance of the best wild root. The Department, therefore, fully indorses the cultivation of American ginseng as an additional resource of the American farmer.

#### DIVISION OF POMOLOGY.

##### WORK DURING THE YEAR.

The distribution among experimenters, in different sections of the country, of trees, scions, cuttings, plants, vines, and seeds of fruit-bearing varieties and species amounted to 200 lots, including 185 varieties and 26 species.

In preparing an exhibit of fruit models for the Trans-Mississippi International Exhibition at Omaha a plan was adopted by the Division which would furnish information to observant visitors as to the appearance and varied characteristics of important fruits. The exhibit was divided into groups illustrating the principal commercial apple grown in the trans-Mississippi region, the varieties adapted to dessert and other uses in the same region, Russian and crabs, new and small varieties, and specimens of the leading commercial and dessert fruits of the United States.

A special investigation of the fruit districts of the Pacific slope was made during the year, and the results will be included in the next revision of the Fruit Catalogue, to be issued during the coming fiscal year. For this purpose I appointed Prof. E. J. Wilson, of the University of California, a special agent of this Division for a period of six months; also Prof. W. H. Ragan, of Greencastle, Ind., as special

agent for three months. Professor Ragan is chairman of the committee on revision of Catalogue of the American Pomological Society, and the appointment was made in recognition of the cooperative work undertaken by this Division with the society in the revision of this catalogue.

Descriptions of 485 fruits were added to the files, 75 wax models were completed, and 200 water colors were made during the year.

#### WORK IN PROGRESS.

An investigation of the present status of the cultivation of the European grape in the Southeastern section of the United States is being made. This is being done in cooperation with the Section of Seed and Plant Introduction, for the purpose of determining the advisability of renewed efforts in the introduction and cultivation of varieties of *Vitis vinifera* on resistant stocks in that region.

Many of the promising fruit-bearing species of foreign countries referred to in last year's report will soon be introduced into this country for experimental cultivation.

#### DIVISION OF PUBLICATIONS.

##### MEDIUM FOR DIFFUSION OF INFORMATION.

The Division of Publications is the medium for the diffusion of the information acquired by the various Bureaus, Offices, and Divisions of the Department. The results of the investigations for the promotion of agriculture and the information acquired by the corps of scientists and experts are made available through various forms of publications, of which 501 were issued during the year, and the total number of printed copies amounted to 6,280,365. These publications comprised technical reports and popular bulletins, and circulars on agricultural and kindred subjects, and they were distributed as promptly as our facilities afforded to the very large proportion of our people interested in or actually engaged in farming pursuits. Notwithstanding the large number of copies of publications distributed, they were not sufficient to meet the demands; and it is evident that only by an increased appropriation will it be possible to place the results of the work of this Department in the hands of all who are justly entitled to the same.

It is extremely gratifying to know that a knowledge of the Department and its usefulness is more widely prevalent than at any time in its history. This is due in a measure to the great increase in the number of small popular pamphlets and the wide distribution of them. At the same time there has been no retrogression in the scientific and technical reports which record the investigations and researches made by our scientists and experts, and afford a permanent record of our achievements in the various realms of inquiry. These bulletins



have been distributed with the greatest possible discretion. As regards all the bulletins and reports, the effort has been to place them in the hands of the persons who actually need them, and to deny the publications to all who apply for them simply to gratify a desire to obtain something because it is free.

#### THE YEARBOOK.

An interesting feature was added to the Yearbook for 1897, consisting of a series of 19 papers, aggregating 220 printed pages, prepared by the various chiefs of Bureaus, Offices, and Divisions, setting forth the work of each in relation to the farmer. The Yearbook also contained 18 miscellaneous papers on agricultural and kindred subjects, besides my preliminary report and the appendix of useful information, aggregating 786 pages. In this connection, I am constrained to recommend an increase in the quota of this publication allotted to the Department. For several years this allotment has consisted of only 30,000 copies, which is inadequate to supply the correspondents and others who receive no other compensation for the valuable services they render the Department, to say nothing of the demands from miscellaneous applicants, both domestic and foreign. For such purposes there should be at least 20,000 copies, making the entire quota of the Department 50,000, while Congress might order for the exclusive use of its Senators and Members such number as it sees fit, its proportion now being 470,000 copies. It is safe to say that the growing popularity of the Yearbook is due to its improved character and to the increased knowledge in regard to it.

The preparation of the volume for 1898 is already far advanced, and for 1899 I am considering the propriety of making a special effort to prepare a publication which shall contain a résumé of the achievements in the United States in every branch of science as related to agriculture during the nineteenth century for distribution at the Paris Exposition. At least 50,000 copies could be advantageously distributed, and I have no doubt Congress will vote an increased appropriation for such purpose.

#### FARMERS' BULLETINS.

The amount expended for printing Farmers' Bulletins during the year was \$32,756.46, the total number of copies being 2,170,000, of which 1,580,000 were distributed upon the order of Senators, Representatives, and Delegates in Congress, the quota of each being 4,000 copies. Heretofore the quota was 5,000 copies, which was reduced because of the insufficiency of the appropriation for these bulletins. Requests from Members of Congress for additional copies aggregating over 100,000 copies had to be refused, owing to this cause. The growing demand for these bulletins warrants the recommendation that

adequate funds be made available for their preparation, printing, and distribution.

#### THE DISTRIBUTION OF DOCUMENTS.

The distribution of the publications of the Department has proceeded in accordance with the law of January 12, 1895, occupying the time and energies of the considerable force of employees necessary to mail, including publications and circulars, more than 7,000,000 documents. A special effort has been made to prevent duplication, and this precaution has made it possible to supply many deserving persons who would otherwise have been deprived of the publications.

The documents turned over to the Superintendent of Documents have met with ready sale, outnumbering those of all the other Departments combined, the amount which he realized from such sales being \$2,089.15. The sum so realized should be made available for reprinting the publications that become exhausted, thus renewing the supply for the benefit of those who are willing to pay the nominal price affixed.

#### AN UNJUST RESTRICTION.

I feel constrained to again recommend the repeal or alteration of the provision of the act providing for the public printing and binding and the distribution of public documents, approved January 12, 1895, which restricts to 1,000 copies in any one year all publications exceeding in size 100 octavo pages. Not infrequently a most valuable report is necessarily larger, and the restriction referred to prevents its proper dissemination, withholding from many people, specially interested, valuable information to which they are entitled. It is earnestly hoped that Congress will speedily remove this and every other barrier, so as to allow the widest possible diffusion of the information acquired by the Department.

#### DIVISION OF STATISTICS.

##### INVESTIGATIONS OF THE YEAR.

The principal work of the Division of Statistics consists of the collection and publication of information concerning the condition, acreage, and production of the principal products of the soil, and the number, value, and condition of farm animals.

Among the subjects which have been investigated by the experts of this Division are the consumption of commercial fertilizers, the changes in the rate of charge for railway and other transportation services, the cost of raising a bale of cotton, the production of sugar in the United States, the world's production and consumption of wool, and the application of the principle of cooperation to farming or for the farmers' benefit. Reports on the two first mentioned have been published. The others are in progress.

## IMPROVEMENT IN CROP REPORTING SYSTEM.

One of the most important duties devolving upon this Division is crop reporting. The Statistician has devoted special attention to the subject of improving these reports and organizing a system which shall be less cumbersome and more efficient. During the year the number of State agents has been increased from twenty to forty-one, and the relative increase in the reports received from voluntary reporters, both county and township, has been very considerable. The Statistician earnestly recommends, as a further step in securing efficient service and adding to the value of the improvements already secured, the appointment of five traveling inspectors, whose duties shall include the periodic visitation of State and county agents, and who shall visit the principal agricultural regions after seedtime and during critical periods of the growing season, and finally, after harvest, reporting the results of their observations to the Statistician. In view of the value of these reports, it is to be regretted that Congress reduced the appropriation for this Division for the current year.

## IMPOSSIBILITY OF ANTICIPATING FINAL OFFICIAL FIGURES.

For many years charges have been made that certain operators on the different produce exchanges have had in their possession, several hours in advance of publication, statements relative to the crop reports alleged to have been obtained from official sources. In many cases the figures closely corresponded with the figures subsequently announced by this Department. It was evidently necessary to make such allegations impossible, and without reflecting upon anyone of the employees of the Division, changes have been made in the handling of the returns which make it practically impossible for anyone to anticipate the final official figures. The fact that since these changes were made the discrepancy between the figures claimed to have been prematurely obtained and those actually published by the Department has been marked is a matter of congratulation, and should confirm the falsity of any such allegations in the future.

## INVESTIGATION OF THE CONSUMPTION OF WHEAT.

Owing to the uncertainty that prevails as to the annual per capita consumption of wheat and the difficulty of obtaining absolutely reliable information concerning the amount produced from year to year, it is proposed to so extend the work of this Division as shall enable the Department to speak with a greater degree of confidence and authority concerning the much-discussed food problem of the United States and the world at large. To this end it is proposed to establish a record of movement and supply, which will prove a valuable check upon the statistics of production and pave the way for an

investigation of the consumption of wheat in certain typical communities that would be of the highest statistical and economic value.

In connection with this work the five traveling inspectors already recommended could be employed to great advantage.

#### CROP-REPORTING SYSTEM FOR NEW TERRITORY.

The recent acquisition of territory brings under control of the United States islands the products of whose soils are so large and of such vital importance that adequate provision must be made for the establishment of an efficient system of crop reporting in all these islands.

#### DIVISION OF ACCOUNTS AND DISBURSEMENTS.

##### IMPROVED BUSINESS METHODS.

The regulations governing financial transactions with the Department have been thoroughly revised during the year and made to conform with new and amended laws, as well as with recent rulings of the Treasury and the Department of Justice. Thus revised, the regulations have been published and supplied to persons interested.

The Accounting Officer of the Department has performed an important service during the year by aiding in the formulation of a more satisfactory method of public advertising and settlement of accounts in that connection, by which uniformity, accuracy, and a permanent record of details have been secured and a great saving of money effected. In the consideration of such questions he acted in connection with a committee of representatives from the Executive Departments, with the Chief Clerk of the Treasury as chairman. A better form for requests for transportation for persons traveling on Government business was adopted at the same time. Another step in the direction of improvement of business methods was the assignment of a well-qualified official to the duties of law clerk.

##### RECEIPTS AND EXPENDITURES.

During the year there were received, audited, and paid by the Department 15,576 accounts, including supplemental accounts for 1896 and 1897, as follows: Divisional, 4,658, amounting to \$847,621.64; Bureau of Animal Industry, 3,606, amounting to \$733,901.66; Weather Bureau, 7,312, amounting to \$830,437.55; and the settlement of these accounts required the issuance of 25,593 checks.

From the appropriations for 1898 the total disbursement through the Department prior to July 1, 1898, was \$2,245,334.08. There remained at that date unpaid bills for that year aggregating \$170,000. When these shall have been paid there will be a final balance to return to the Treasury of nearly \$50,000.



The total amount paid out during the year was \$2,411,960.85, which includes supplementary payments for 1896 and 1897. The accounts for 1896 were finally closed and \$488,833.58 was covered into the Treasury as an unexpended balance.

During the year \$8,071.06 was received from sales of Government property and for services, and will go into the Treasury as part of the surplus for the year. Of this amount, \$4,220.19 is made up of receipts from the seacoast telegraph lines and \$3,464.61 is from sales of condemned property.

A perusal of the foregoing review of the operations of the Department during the past fiscal year justifies the statement that the record of the year has been one of the most satisfactory growth and development. There has been manifested in many ways a widespread interest in the work of the Department and an appreciation of the value of its investigations to the producers of this country. The demand for information from the Department has been unprecedented, and covers the greatest variety of agricultural problems. Day by day the fact is more and more fully acknowledged that the services of the Department to the producer are of the first importance, and such as can be rendered to him through no other agency.

Respectfully submitted.

JAMES WILSON,  
*Secretary.*

WASHINGTON, D. C., *November 23, 1898.*



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DEPARTMENTAL REPORTS.

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# REPORT OF THE ASSISTANT SECRETARY UPON THE PURCHASE AND DISTRIBUTION OF SEEDS.

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE ASSISTANT SECRETARY,  
*Washington, D. C., September 21, 1898.*

SIR: Having, at your direction, assumed general charge of the distribution of seeds, I have the honor to transmit herewith reports for the year ending June 30, 1898, of Messrs. Whittleton, Fairchild, and Wiley, all of whom participated in the distribution.

Congress appropriated "for the purchase, propagation, and distribution of valuable seeds, bulbs," etc. .... \$130,000.00

Of this amount there was expended for general distribution, as shown by Captain Whittleton's report .....	86,106.65
For foreign seed purchased by Professor Hansen and distributed by Professor Fairchild, special agent in charge of seed and plant introduction .....	14,520.00
For beet seed, purchased and distributed by Dr. Wiley .....	2,846.76
For other expenses connected with the distribution .....	20,120.95
<b>Total</b> .....	<b>123,594.36</b>

There remain unpaid at this date several vouchers, which will increase to some extent the total expenditure. It should also be noted that of the amount reported expended by Captain Whittleton, 10 per cent was reserved until it could be determined whether the seed furnished by the contractors germinated to the standard required by the Department; hence this item is only approximated.

In the distribution of the seed every effort has been made to place them where the best results might be expected. We have filled every request received that it was possible to fill, making, in a number of cases, special purchases to meet requests for seed not included in our general contract.

Reports from persons who have received and planted the seeds are, with scarcely an exception, very favorable. It is too early as yet to determine whether the seed introduced from foreign countries will prove valuable in this country or not, but we have every reason to believe that some varieties will prove to be very desirable.

A great deal of clerical work has been necessary in connection with this work. Accounts have been kept in the Seed Division of all seed

sent out under the general distribution by Members of Congress; and in the distribution of foreign seed a receipt has been exacted from all persons to whom the seed was sent, and they have agreed to report the results of their trials to the Department. The beet seed was distributed to sections that were thought best adapted to their use, including agricultural experiment stations, and persons to whom the seed were sent were also advised that the State experiment stations would make analyses of the sugar beets grown in each State.

Owing to the fact that the seed was distributed by our contractors at Toledo, Ohio, it was found necessary to send a special agent, with clerical help, to that city, whose duty it was to oversee and supervise the general distribution.

Respectfully,

J. H. BRIGHAM,  
*Assistant Secretary.*

Hon. JAMES WILSON, *Secretary.*

#### REPORT OF THE ACTING CHIEF OF THE SEED DIVISION.

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE ASSISTANT SECRETARY,  
*Washington, D. C., August 18, 1898.*

SIR: In compliance with circular letter dated June 30, 1898, I have the honor to submit herewith a report of the distribution of seeds and the work of the Seed Division, in its connection therewith, for the fiscal year ending June 30, 1898.

I would first respectfully call your attention to the fact that this report will treat only on the seeds distributed through Congressmen (by their allotments) and such others of a miscellaneous character as may have been directed by the Secretary, and *not* of the seeds imported by the Department and distributed under the supervision of other division chiefs.

The records of this division under this head show that the aggregate number of papers and bags (cloth) of seeds distributed during the fiscal year ending June 30, 1898, were as follows:

Vegetable .....	papers..	14,243,527
Flower .....	do .....	1,254,037
Field .....	papers and bags..	205,350
Total .....		15,702,914

This total of 15,702,914 papers and cloth bags of all seeds were divided in their distribution as follows:

To Senators, Representatives, and Delegates in Congress, 13,599,586 papers and cloth sacks of vegetable, flower, and field.

To correspondents of the Division of Statistics, 751,170 papers of vegetable and flower.

To Weather Bureau observers, 45,635 papers of vegetable.

To experiment stations, 900 papers of vegetable and flower.

To the Office of Pure Seed Investigation, 7,628 papers and cloth bags of vegetable, flower, and field.



To State granges, 889,460 papers and cloth bags of vegetable, flower, and field.  
To postmasters, 181,847 papers and cloth bags of vegetable, flower, and field.  
To Clerk of House of Representatives, 5,560 papers of vegetable.  
To Sergeant-at-Arms, House of Representatives, 1,565 papers of vegetable and flower.

Miscellaneous distribution by the Department, 219,473 papers and cloth sacks of vegetable, flower, and field seeds.

The above distribution began on January 10, 1898, and was completed on May 17, 1898.

All of the foregoing seeds, together with all labor and material necessary to carry on and complete the distribution, were furnished by the Henry Philipps Seed and Implement Company, of Toledo, Ohio, with whom the Department had entered into contract for the full and faithful performance of the same.

The aggregate cost of all seeds furnished for distribution amounted to \$86,106.65.

Respectfully,

R. J. WHITTLETON,  
*Special Agent, Acting Chief of Seed Division.*

Hon. J. H. BRIGHAM,  
*Assistant Secretary.*

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## REPORT OF THE SPECIAL AGENT IN CHARGE OF SEED AND PLANT INTRODUCTION.

U. S. DEPARTMENT OF AGRICULTURE,  
SECTION OF SEED AND PLANT INTRODUCTION,  
*Washington, D. C., September 17, 1898.*

SIR: Prof. N. E. Hansen, appointed May 25 as a special agent of the Department, visited during the past year portions of Russia and Siberia with a view to securing seeds and plants valuable for introduction into this country, and a report of the results of this expedition, together with the work of the Section of Seed and Plant Introduction in the distribution of the seeds and plants secured, is respectfully submitted. Professor Hansen's full report is reserved for such publication as is deemed advisable.

Professor Hansen, in the course of his exploring trip, visited the principal nursery-growing regions of northern and central Russia, and pushed eastward toward the southeastern portion of Russia, visiting the cereal-growing regions of eastern Russia and western Siberia (Amu Daria, Bokhara, Samarcand, Tashkent, Omsk), and returning by way of the Siberian railroad. This entailed a trip of some 2,000 miles overland by tarantass (the native cart).

In the course of these explorations in Russia and east of the Caspian Sea, Professor Hansen succeeded in making a collection of 1,124 numbers, including no less than 57 varieties of vegetable seed, 289 of melon, 75 fruit and berry plants, 150 ornamental plants, 70 wheats, 14 barleys, 20 oats, 6 ryes, 70 forage plants, 5 oil-producing plants, a large number of miscellaneous seeds of desert plants, etc. These seeds and plants upon arrival were put up into about 5,000 packages, which were sent out largely to the State agricultural experiment stations and such reliable cultivators as had shown a willingness to cooperate with

the Department in making reports as to the success of these imported plants. Careful record has been kept of every package sent out, receipt cards being signed by the parties receiving the packages. Report vouchers have been sent to each of these parties, and the reports when returned will be placed on file in this office for public reference. As the season is not yet over, reports on the imported seeds and plants have not been received. Furthermore, owing to the necessary work of disinfection and careful cleaning, all of the importations have not been distributed.

While it is too early to predict the fate of most of the introductions, and it is true, as in all cases of plant introduction, that only a small percentage is expected to prove better adapted to our soil and climatic conditions than the varieties already grown, the following may be mentioned as promising:

A variety of alfalfa, differing slightly from the kind grown in this country, and which is claimed to be more drought resistant, was imported in considerable quantities, and very largely distributed through the arid regions of this country.

Seedlings of the Siberian Apple (*Pyrus baccata*) were imported in quantities for experimenting in the Dakotas, particularly with a view to the discovery of a stock which would not be killed by the severe frosts of that region. Professor Hansen is carrying on experiments personally with these stocks, and it is hoped by their means to make apple growing a possibility for this northern region. *Bromus inermis*, a forage crop already tested in California and proved to be a great success, was imported in large quantities and distributed generally through those regions in which it will probably prove successful.

A new orange-fruited raspberry (*Rubus xanthocarpus*) was discovered in northern China by Russian explorers. Professor Hansen claims to have secured the whole stock of this raspberry, which, according to the reports received, will grow wonderfully well in the climate of the Northern States. Should it not prove of direct value it will undoubtedly be of great service in the breeding experiments which are being carried on with this genus of cultivated plants.

The Russian Sand Vetch (*Vicia villosa*) was imported in large quantities and distributed to those farmers who are likely to make a success of the crop.

Russian watermelons and muskmelons were imported in large quantities, but as yet the reports regarding the success or failure of the different varieties have not been received. It is probable that some of them will prove valuable for breeding purposes especially, although it is not to be expected, from the immense development of melon growing in this country, that a variety superior to those already grown can easily be secured from such regions as Russia and Turkestan.

Owing to the great length of time required to carry on the correspondence with the parties from whom Professor Hansen secured the seeds and plants mentioned, all the bills incurred by him may not have been received, but the expenses involved in the introduction of the seeds and plants may be estimated at \$14,520.

Respectfully,

D. G. FAIRCHILD,

*Special Agent in charge of Seed and Plant Introduction.*

Hon. J. H. BRIGHAM,

*Assistant Secretary.*

# REPORT OF THE CHIEF OF THE DIVISION OF CHEMISTRY ON THE DISTRIBUTION OF SUGAR-BEET SEED.

U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF CHEMISTRY,  
*Washington, D. C., September 16, 1898.*

SIR: The following is a statement of the expenditures for sugar-beet seed during the past season and of the distribution of such seed:

In all, 34,436 pounds of seed were purchased, at an expense of \$2,846.76. Of this seed, 16,616 pounds were procured from Messrs. Vilmorin-Andrieux & Co., of Paris, and the remainder from Messrs. Dippe Brothers, of Quedlinburg, Germany. The greater part of the French seed was of the Vilmorin White Improved variety. The German seed was all of the Kleinwanzlebener. In addition to the above seed, 220 pounds were donated by a German grower, Mr. Strandes, and a number of small sample packages were obtained from various other growers.

The seed was partly distributed in bulk and partly in packages containing approximately 18 ounces each. Large quantities were distributed by Members of Congress and a few sacks of 110 pounds each were sent to individuals for distribution.

Forty pounds of extra high-grade seed were distributed among experiment stations for use in the production of seed; 24,000 pounds of seed were distributed by the experiment stations, and 10,436 pounds by the Department.

In the general distribution of seed no application was refused, though in many instances where requests were made for several pounds a single package only was sent.

The following amounts were expended for sugar-beet seed:

Variety.	Quantity.	Amount expended.
Dippe Bros.:	<i>Pounds.</i>	
Kleinwanzlebener .....	15,400	\$1,279.36
Do .....	2,200	195.60
Do .....	220	10.00
Vilmorin-Andrieux & Co.:		
Vilmorin's White Improved .....	16,464	1,342.74
Various varieties (French and Russian) .....	40	4.50
Vilmorin's French, very rich .....	28	3.64
Vilmorin's Kleinwanzlebener .....	84	10.92
Total .....	34,436	2,846.76

Respectfully,

H. W. WILEY,  
*Chemist.*

Hon. J. H. BRIGHAM,  
*Assistant Secretary.*





## REPORT OF THE CHEMIST.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF CHEMISTRY,  
*Washington, D. C., September 7, 1898.*

SIR: I have the honor to submit herewith for your consideration the executive report of the Division of Chemistry for the fiscal year ended June 30, 1898.

Respectfully,

H. W. WILEY,  
*Chemist.*

Hon. JAMES WILSON, *Secretary.*

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## WORK OF THE YEAR.

### COMPOSITION AND ADULTERATION OF FOODS.

The investigations made in this line during the year ended June 30, 1898, were directed chiefly to completing the work on cereals and cereal products. The analyses, by the best modern methods, of samples of typical cereals collected from all parts of the United States afforded a reliable basis for the study of cereal products. Under the term "cereal products" are included the flours and meals made from cereals, together with the waste products incident to their milling and preparation. Since the chief object of the study is the composition and character of man foods, the studies of the waste or side products has only been of an incidental character. The number of such products is very great, including bran, germs, and coarse products of various degrees of nutritive value. These products are used chiefly for feeding domestic animals, but their nutritive and economic importance must not be neglected. So perfect has the system of milling cereals become and so sharp the competition, that a miller who would neglect the side products of his industry would speedily find the markets closed against him.

Starting from the mean composition of the principal cereals, as indicated above, the chemical studies of the products made therefrom have included the flours and meals, breads of every description, breakfast foods, sweetened cakes, and biscuits. In order to have the samples represent as nearly as possible the character of the products actually found on the markets they were bought, with few exceptions, in the open market, without intimation to the seller of the purpose to which they were to be devoted. While this method is the best

for ascertaining the character of cereal products entering into consumption, it renders a proper classification of the purchased samples extremely difficult. These products are often sold under names which are either misleading or wholly un-descriptive. In classifying the results of the analyses in tabular form, therefore, it was often uncertain where a given sample belonged. In many cases, however, the description obtained on the purchase of the sample was at least a guide to classification, and those samples which were wholly undescribed were classified together as miscellaneous. In so far as is necessary to an accurate comprehension of the manner in which the various products are obtained, a brief description of the processes of milling and separating the milled products and methods of fermentation and baking are given. These are in no sense technical in their nature, but only in a general way descriptive of the chief methods of preparation. The chemical studies of these bodies have in many cases been supplemented with experiments in artificial digestion. By these studies the effect of the different methods of preparation and baking on the digestibility of the nitrogenous constituents has been determined.

Further, there has been marked out during the year a method whereby the heat-forming value of these foods can be accurately calculated from the data obtained by chemical analysis. This relation was established by an experimental study of the calories of combustion of the food products in compressed oxygen. The result of this work has been the addition to chemical processes of a new method of testing the accuracy of work. It is evident that a system of comparison established by hundreds of experimental determinations will furnish a valuable guide in the study of analytical data. Wherever there is a marked deviation between the numbers representing the calories of combustion determined directly and by calculation, the analyst is certain that some fault in the work must exist. These methods, which are purely scientific, have been published in various scientific journals. All the results of the work above outlined are collected and published as Part IX of Bulletin No. 13 of this division.

The researches made by this division in respect of food adulteration have been richly supplemented by the work of chemists in many of the States. The result has been the enactment of State laws regulating commerce in adulterated foods. As types of these laws, the statutes of Massachusetts, Connecticut, Ohio, and Kentucky may be cited. Many of the other States also have laws more or less comprehensive on the subject. The necessity of national legislation on this subject has long been apparent, for it is evident that State laws, however excellent and well executed, can not realize their full purpose without the supplement of Federal legislation. Bills regulating interstate commerce in adulterated foods are now before Congress and have met with your approval.

During the year extensive studies have been made in simple methods of detecting some common adulterants, and a report on that subject was presented to the Association of Official Agricultural Chemists and published in the last volume of the proceedings of that association.

An interesting study in the history of food adulteration has also been made in which many ancient laws relating to the matter have been discovered. This valuable contribution to the literature of food adulteration has been published in *Science*. The interests of honest agriculture, as well as of public health, are directly concerned in these studies.

## COOPERATION WITH OFFICIAL CHEMISTS.

The valuable results of the cooperative work of the Department of Agriculture with the official chemists grow annually in importance. The official chemists who take part in the cooperative work are those connected with the various experiment stations and agricultural colleges, chemists attached to State boards of agriculture, State dairy control, and other industries employing chemists under State authority or direction, chemists of State boards of health, and municipal chemists and all others exercising in any way official control over food or other agricultural products. The total number of chemists in the United States eligible to membership in the Association of Official Agricultural Chemists is estimated at about 300, and nearly 100 attend the annual meetings. The Division of Chemistry, from the inception of this organization, fourteen years ago, has been in most intimate relations with it, and the Chemist has been the secretary and executive officer of the association for eleven years. The proceedings of the association are published annually as a bulletin of the Division of Chemistry, as are likewise the official methods of analysis authorized by the association. As a result of this systematic study of methods of investigation of soils, fertilizers, and agricultural products, the United States has now a uniform method of research everywhere practiced and recognized as official, both by trade chemists and the courts of justice. The nations of Europe have been impressed with the value of this work and are now organizing similar associations. It can be safely said that the value of the cooperation of this division, standing as it has for fourteen years as the recognized leader in this movement, is inestimable.

During the time of your administration the bond of union between the Department and the association has been strengthened, both by your personal participation in the meetings of the association and by your cordial sympathy with the aims and motives of its work. A perusal of the volumes containing the proceedings of the association will show how large a part of the work has been done under the auspices of this division and how cordial has been the cooperation between its members and the other members of the association. In view of the facts presented above, the question arises whether it would not be proper to recognize in some more official way the intimate relations outlined. A recommendation by you to Congress to recognize the existence of the Association of Official Agricultural Chemists by appropriate legislation would be warmly appreciated by the members of that body and give additional weight to its proceedings, both among foreign nations and in courts of justice.

## STREET SWEEPINGS, GARBAGE, AND SEWAGE.

During the year the division began a study of the agricultural value of street sweepings, garbage, and sewage. The question of the disposal of these materials is one which has long puzzled municipal authorities. The general value of these waste materials for fertilizing purposes has long been recognized, but no systematic study of them, from a chemical-agronomical point, has heretofore been undertaken. Circulars were sent to all towns of over 10,000 inhabitants in the United States, asking in detail for information in regard to the disposal of street sweepings, garbage, and sewage. Similar circulars were sent to our consular agents in Europe. The replies to these circulars have been quite general, and



the division is now in possession of information, which has already been tabulated, concerning the methods of street sweepings, garbage, and sewage disposal in all of the principal cities of America and Europe. Large numbers of samples of sweepings and garbage have been obtained, and many of them were analyzed during the year. When the work is completed it will be possible, for the first time, to make a systematic publication of the comparative methods of disposing of these troublesome materials and of the value which they have for agricultural purposes. With the aid of this information, municipal authorities and farmers will be able to determine how far it will be practicable to transport such material for fertilizing purposes, and great mutual benefit will ensue.

#### SOIL STUDIES.

The study of the comparative producing power of various soils, under controlled conditions, has been continued on the lines of investigation defined in previous reports. These soils have been studied by many different methods of chemical examination, and since the last report two additional crops have been grown on them. The importance of continued studies is shown in the fact that although the control of moisture and cultural conditions has been rigidly the same for six successive crops, remarkable variations in yield have been observed. This shows that those atmospheric and climatic conditions (moisture excluded) which are beyond human control, have a great potency in crop production. These causes are chiefly heat and light. There are, however, evidently other meteoric causes which must be considered. These experimental data throw new light on the fact which has long been observed, namely, that the great variations in yield in successive years in agricultural crops are not dependent on the distribution of the rainfall alone. The solar influences are evidently of great importance, and the distribution of solar heat is a factor not to be neglected. Excessive or deficient temperatures at critical moments of the growth of a crop are doubtless factors of prime importance in harvest products. The factor of "soil fatigue" is also one not to be neglected, and this factor is shown in the tendency of the soil to rest after the gathering of a rich harvest. In the experimental studies of the year the influence of these various factors has been manifest. It is evident that valuable conclusions can not be drawn from a few studies of this kind. It is only after a series of years that the relative magnitudes of the various uncontrollable factors begin to assume definite shape.

#### COOPERATIVE WORK WITH THE TREASURY.

Under your direction, the Chemist undertook, at the request of the Secretary of the Treasury, the work incident to the chairmanship of a commission to establish the methods of polarizing sugars for dutiable purposes at the ports of entry, and for preparing suitable regulations therefor. This was supplemented by an investigation, conducted in the laboratories of the collectors and appraisers of the ports of Philadelphia, New York, and Boston. Preliminary to this investigation a long series of research investigations was made in the laboratory to properly standardize the necessary apparatus and to fix the values of the several quartz plates. The Chemist, having been



appointed a member of the international committee to fix sugar standards, made use of the data of these investigations in preparing a paper to present to the Third International Congress of Applied Chemistry at the Vienna meeting. A detailed report of the investigations which have been made has been submitted to you for transmission to the Secretary of the Treasury. The purely technical part has been included in papers to be presented to the Vienna Congress and to the American Association for the Advancement of Science at the Boston meeting. These technical papers will be published in the proper scientific journals. It is evident, from the investigations which have been made, that there is great need of an international agreement in all that pertains to the official determination of the true content of sugar in a given sample. Constant differences are found to exist in the results of analyses in different countries, and even by different chemists in the same country. Disputes and suits at law often arise from these differences, and these can only be prevented by the adoption of some international standard of sampling and analysis. To this end the results of our work during the year will be helpful, and the continued cooperation of the division in similar researches advisable.

#### SUGAR-BEET INVESTIGATIONS.

The widespread interest throughout the country in the culture of the sugar beet led to a renewal of the work of the division in these investigations. Cooperative work was established with the experiment stations and with several thousand farmers. The production of high-grade beets for seed propagation was one of the chief objects kept in view in the cooperative station work, and the influence of climate on the character of the beets was the principal study in cooperation with the farmers. The magnitude of the analytical work in both fields of investigation was very great, many thousands of analyses having been made. The analytical data obtained were studied with a view to a proper classification, facilitating further studies. From the stations high-grade beets were preserved for seed propagation, and after analysis the beets were preserved over winter and redistributed to the stations in the spring for seed production. A few of the high-grade beets were planted in the Department garden.

The studies of the miscellaneous analyses, together with a comparison of all the available analyses made during the past ten years, led to the construction of a map showing the probable area in the United States where beets of a superior quality could be produced. All the data bearing on the subject are published in a special report by the Congress of the United States. The results of the analyses show that there are many localities in the United States where beets can be grown quite equal in saccharine strength to those produced in Europe. There is lacking, however, among our farmers knowledge of the proper methods of cultivation; and a certain indisposition is shown to exercise the care in tillage which is necessary to secure the best results. The data further show that where contour and character of land are favorable, and there is a proper distribution of rainfall, the best beets are produced on a belt of varying width, through which runs the isotherm of  $70^{\circ}$  for the months of June, July, and August. The data further show that under irrigation, with other conditions favorable, excellent beets can be produced.

## STUDY OF THE COMPOSITION OF PIGS.

Samples of eight breeds of pigs, grown at the Iowa Experiment Station, were subjected to an analytical study during the year. The carcasses of these animals were sent to the laboratory from the slaughterhouse in Chicago. Each carcass was systematically dissected into representative parts, and these prepared for analysis. It is easily seen that only with extreme care is it possible to secure representative samples of such materials. After the analysis of each part the data obtained were calculated to the fresh material in the state in which it was received at the laboratory. The pigs were not only of different breeds, but they had been subjected to different methods of feeding. The data, therefore, show not only the influence of breed, but also of food, on the character of the product. These studies, when fully completed, will not only afford valuable data to the swine grower, but also to the food economist. Although the chemical work is of the most exacting kind, yet the end in view appears sufficiently valuable to warrant the extension of the same method of investigation to all domestic animals used as human food.

## COOPERATION WITH OTHER DEPARTMENTS.

Attention has already been called to the cooperative work undertaken by the division, with the Treasury, in relation to the collection of duties on imported sugars. In various other ways the division has also assisted the Treasury and other Departments of the Government.

Section 61 of the tariff act of August 27, 1894, provided for a rebate of the tax on alcohol used in the arts and in the manufacture of medicinal or other like compounds, when the alcohol was used under regulations to be prescribed by the Secretary of the Treasury. On June 3, 1896, this provision of the act just mentioned was repealed by a special act of Congress, which also provided for a joint select committee, composed of three members of the Senate and three members of the House of Representatives, whose duty it should be to consider all arguments pro and con relative to the granting by Congress of tax-free alcohol for use in the arts and manufactures of the country. During the twenty-one months intervening between the passage of the tariff law of 1894 and the repeal of section 61 thereof, the Secretary of the Treasury did not find it practicable to establish the regulations necessary for the execution of the rebate provision. Consequently, the Court of Claims was deluged with claims for a rebate of the tax paid on alcohol used by various manufacturers. Much expert chemical testimony was presented in support of those claims. At the request of the Assistant Attorney-General in charge of the cases, the testimony of the chemists testifying for the plaintiffs was carefully reviewed by the Division of Chemistry, and many laboratory experiments were made which required the time of one chemist for several weeks. The result was the presentation of valuable testimony in support of the Government's position and in rebuttal of the testimony of the witnesses for the plaintiffs.

The Post-Office Department during the year referred to this division a number of inks, with a request that a study be made of their comparative merits for use in the cancellation of postage stamps. Many laboratory experiments were made, and a full report of the results was transmitted to the Postmaster-General.

A similar request came from the State Department in regard to an

ink and typewriter ribbon which it was proposed to use for the permanent records of that Department. A careful chemical study of the ink and ribbon was made, and the results were duly transmitted to the Secretary of State.

From the War Department several samples of wheat flour, supposed to be adulterated with maize meal, were sent for examination. From the customs division of the Treasury a large number of samples of concentrated fruit juices was received for the purpose of ascertaining their exact composition, in order to properly classify them for duty. The Division of Chemistry, in accordance with your instructions, holds itself in readiness to comply, in the shortest possible time, with all reasonable requests of the other Departments for chemical services. Inasmuch as this partial collaboration has been going on for years, the thought is naturally suggested that all the chemical work of the Government might with great economy and administrative advantage be placed under a single direction. The United States could well afford to erect and equip a model laboratory for the prosecution of all the various forms of chemical investigations which the exigencies of the Government require. Unity of purpose and direction are the prime factors which promote economy of administration and attainment of results. The fact that the chemical laboratory of one Department is so often called upon by other Departments of the Government for assistance shows in a practical way that such a union of all official chemical investigations is not chimerical.

#### MISCELLANEOUS WORK.

As in previous years, the division has been called upon to do a great deal of miscellaneous work which can not be grouped under any distinctive head. Miscellaneous analyses of waters used for agricultural purposes, soils, and fertilizers are made from time to time. As a rule, however, such analyses are referred to the several experiment stations of the States whence the samples are sent. In spite of the inadequate assistance in the laboratory, and in the absence of any legal requirement, the division has from time to time undertaken for Members of Congress and others analyses which have no direct reference to agricultural matters. These analyses have been undertaken on request from you, the Assistant Secretary, or the Chief Clerk. Where such analyses tend to promote the public interests or develop directly or indirectly any agricultural industry, there seems to be no valid objection to performing them. It should be understood, however, that the laboratory is not equipped for the analysis of mineral waters, ores, and patent medicines, and hundreds of requests for such analyses are necessarily refused.

#### OUTLINE OF WORK FOR THE YEAR ENDING JUNE 30, 1899.

The work planned for the year ending June 30, 1899, is briefly as follows:

(1) Arrangements for the growth of sugar beets have been made with farmers and experiment stations similar to those described for the preceding year. The number of beets expected for analysis is, however, very much larger than for the past year. Samples of seed were sent to nearly every State and Territory of the Union. Samples for analysis are expected to begin to come by September 15 and continue to arrive until December 15.



(2) The work in the investigation of foods and their adulterants will be continued. The classes of foods proposed for the present study are those for children and invalids. There is a widespread desire for information concerning these varieties of foods, and an attempt will be made to get all the leading brands in the market.

(3) The behavior of typical soils, under controlled conditions, will be further studied and at least two crops, produced under those conditions, be added to those already obtained. It is possible to secure two crops in a year without artificial heat, by growing first oats or beans and following these crops with buckwheat.

(4) Cooperative work with the experiment station chemists and other official chemists will be continued under the direction of the Association of Official Agricultural Chemists.

(5) International cooperative work on methods of analysis of various agricultural products will be continued under the auspices of the various international committees, of which the Chemist is a member, appointed by the Third International Congress of Applied Chemistry at Vienna.

(6) Further work in the investigation of the agricultural value of street sweepings, garbage, and sewage will be carried on.

(7) Investigations of the composition of domestic animals used as human food, as affected by environment, will be continued.

(8) Critical studies of agricultural imports from the countries which exclude similar imports from our country, on the ground of adulteration or unwholesomeness, will be carried on with a view of securing a scientific basis of reciprocal retaliation.

(9) Cooperative work with the various Departments of the Government will be continued as requested.

(10) Such miscellaneous work as relates directly or indirectly to agricultural development will be undertaken, and such other miscellaneous work as may be directed by the Secretary or Acting Secretary of the Department.

#### STATEMENTS REGARDING PLAN OF WORK.

The new laboratory which is in progress of construction will afford increased facilities for work. It is desirable, therefore, that the chemical force of the laboratory be enlarged by the addition of one or two skilled analysts. At the present time all the pay of the watchman and engineer and fireman is charged to the fund provided for additional chemical assistance. This does not seem to be just. Congress appropriates a certain sum for such services, and other divisions, especially those occupying the main building, profit by these services. The Division of Chemistry receives no aid whatever from this source. It is therefore suggested that provision be made in the general estimates for such services, including messenger. This would leave the fund voted by Congress for chemical work wholly for that purpose. It seems that this suggestion is so just as to require no further amplification. The grade of clerk of class 1 should be raised to class 2, to provide for the slight increase in salary which the clerk of this grade received on July 1.

It is hoped that the time may soon come when the skilled scientists of the Department may receive a compensation commensurate with their ability and the time and money they have spent on their education. At present, several skilled chemists in the Division of Chemistry are receiving less salary than is paid for clerical work. The organic



law establishing the Department of Agriculture provides that the scientists employed therein shall receive the same compensation which is given scientists in other branches of the Government. The increase of the salaries of the chiefs of the three original divisions to a sum equal to that received by chiefs of divisions in the Smithsonian Institution, in the Coast and Geodetic Survey, and in the Geological Survey, would therefore be strictly in harmony with the organic law. These chiefs receive from \$3,000 to \$4,500 per annum. The three original divisions of the Department of Agriculture created by the organic law are those of Chemistry, Botany, and Entomology. These, as the senior divisions, are entitled to first consideration, and the salaries of their chiefs should be made \$4,000 per annum.

If the messenger, watchman, and fireman charges are taken off the sums asked for chemical work, the salaries of the present chemists can be modestly increased, and at least one additional assistant employed. This would permit the vigorous prosecution of the lines of work marked out above.

The slight increase in the estimates given below are asked for the purpose of bringing the division back into the high state of efficiency reached under the administration of Secretary Rusk. During the administration of his successor the work of the division was seriously crippled, and the total sum now appropriated for its work is but little more than half of what it was formerly. Under Secretary Rusk, four experiment stations devoted to the study of sugar-producing plants were under the direction of the Division of Chemistry. These stations were all subsequently abolished, and property which had cost nearly \$50,000 condemned and sold for a very small sum. The reestablishment of these stations is not recommended, because of the great cost it would now entail. However, it is earnestly recommended that the sum available for scientific investigations be increased to bring it up to what it was formerly, and to provide for the largely increased amount of work which the division will probably be called on to do.

It will doubtless be found advisable to widen the scope of the study of food and drink adulterations to include those imported from foreign countries. The amount of money formerly voted for this purpose was \$15,000 annually, but in the appropriations for 1895 this was reduced to \$5,000. It is therefore recommended that the sum estimated for this purpose, and to continue the vegetation experiments with soils, be increased to \$10,000. If this be done, and the expense of messenger, watchman, and fireman be included in the general estimates for that service, the scientific work of the division will be able to assume the position which it formerly occupied, and which it is your evident intention it should occupy.



## REPORT OF THE ENTOMOLOGIST.

U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF ENTOMOLOGY,  
*Washington, D. C., July 15, 1898.*

SIR: I submit herewith an executive report covering operations in the Division of Entomology for the fiscal year ending June 30, 1898, dividing it, in accordance with the directions contained in your circular letter of June 11, into the following sections:

(1) A brief report of the operations carried on during the fiscal year 1898.

(2) An outline of proposed work for the fiscal year 1899, under appropriations already made for that year.

(3) Suggestions as to work for the fiscal year 1900, for use in preparing estimates.

Respectfully,

L. O. HOWARD,  
*Entomologist.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

The amount appropriated by Congress for entomological investigations (aside from the salaries provided for by the statutory roll) was \$20,000. Of this amount, there was expended the sum of \$19,438.69, leaving an unexpended balance, which was covered into the Treasury, of \$561.31. The main items of expense may be grouped as follows: Salaries of investigators and other employees, stationed for the most part in Washington, D. C., \$13,128.88; salaries of field agents, \$2,174.16; miscellaneous office supplies and expenses, \$2,501.21; traveling expenses, \$1,634.44. Of the salaries for investigators and other employees, including field agents, the amount expended for scientific assistants has been \$11,143.04, and for clerical and other assistants, \$4,160.

The work of the division may be classified, as in former years, under the following heads:

(a) Investigations upon specific injurious insects or groups of insects.

(b) Experimental work with remedies.

(c) Determination of specimens sent in by the entomologists of the State experiment stations and by other workers.

(d) General investigations of the life histories of injurious insects.

(e) Work on the geographic distribution of the injurious insects of the United States.

(f) Bibliographic work.

- (g) Preparation of circulars of information.
- (h) Correspondence.
- (i) Mounting and preparation of specimens for permanent preservation.
- (j) Preparation and proof reading of bulletins and reports.
- (k) Work upon the exhibit of insects for the Omaha Exposition.
- (l) Work in apiculture.

Briefly summarized, the work of the division under each of these heads has been as follows:

(a) INVESTIGATIONS UPON SPECIFIC INJURIOUS INSECTS OR GROUPS OF INSECTS.

WORK ON INSECTS FROM ABROAD.

The work on injurious insects liable to be introduced into this country from foreign countries, mentioned briefly in the Annual Report for 1897, has been somewhat elaborated. The Entomologist prepared and published, in the Yearbook of the Department for 1897, an illustrated article on the "Danger of importing insect pests," and in the course of preparation of this article the principal injurious insects of foreign countries received some study. An effort has been made during the year to secure and illustrate all of the principal foreign injurious insects which have not yet reached this country and which are at any time liable to make their appearance upon our crops. A field agent has been stationed during a portion of the year in Mexico collecting injurious insects of that country and studying agricultural conditions with reference to insects.

The entomologist appointed by the Hawaiian Government spent the summer of 1897 in Mexico searching for beneficial insects, and presented the division with a complete set of the scale insects and other parasites which he collected during this work. A specific investigation has been made concerning the so-called Morelos orange fruit worm—an insect which does considerable damage in Mexico by boring into and spoiling the ripe fruit of the orange—and the introduction of which into the United States is greatly feared by citrus growers in this country. The exact distribution of this insect in Mexico has been ascertained—a point of great importance, in view of the fact that Mexican oranges are largely imported into the United States during the autumn months. The claim made by Mexicans to the effect that the worm is restricted to the small State of Morelos, and that the cry in the United States, and especially in California, for a quarantine against Mexican oranges, was not due to any legitimate fear of this insect, but to a desire to be relieved from competition with Mexico, has been disproved, and the insect has been found to abound wherever oranges are grown east of the Sierra Madre Mountains. The Entomologist, from personal observation, is, however, of the opinion that this orange worm has not yet made its appearance in the orange-growing districts of the State of Sonora, so that there need be little fear for the present of its introduction in oranges coming into California by the way of the Sonora railway. Two dangerous imported insects have been discovered during the year: one, the brown-tail moth of Europe, which has been found in injurious numbers near Boston, and the other an apple moth from Japan, which made its appearance in British Columbia just across the border from the United States.



Investigations of foreign insects have not been confined to injurious species, but some attention has also been paid to beneficial species. A step has been taken toward the introduction into California of *Blastophaga psenes*, the insect which is responsible for the fertilization of the Smyrna figs of commerce. The Entomologist visited California in the spring of 1898 and found that conditions were ripe for such an attempted introduction, Smyrna figs and caprifigs being already established in numbers at two points in the State. An agent of the Department at present in Europe will be instructed during the present fiscal year to make an effort to increase the number of varieties of caprifig now growing in California and to introduce the insect itself. Actual introductions of the insect in the spring of 1898 have shown that with the proper packing it can be brought over from Europe to California in excellent condition.

The subject of the importation of predaceous and parasitic insects has not been neglected. Arrangements have been made to attempt the introduction into this country from Europe of tree-inhabiting predatory beetles which prey upon the gipsy moth and other tree caterpillars. With the help of the Station of Agricultural Entomology at Portici, Italy, a successful importation has been made of an important parasite (*Scutellista cyanea*) of certain large scale insects. Accidental importations of two other important parasites have been discovered and arrangements have been made to further their spread in this country. An important Coccinellid enemy of Lecanium scales has been discovered in Arizona by one of the assistants of the division, and an attempt to colonize it upon the black scale in California olive groves has been prevented only by the serious illness of the assistant who was charged with the work.

#### THE GIPSY MOTH.

In the clause making appropriations for this division for the fiscal year ending June 30, 1898, an investigation of the gipsy moth in Massachusetts was directed. During the summer of 1897 the Entomologist made a careful study of the work which is being done under State appropriations against this imported insect pest for the purpose of deciding in accordance with the intent of the clause in the appropriation bill whether, first, the State is doing the best thing in making large annual appropriations for the purpose of endeavoring to exterminate the species, and, second, whether the work is being done in the best and most thorough way by the committee to whom it has been confided. He reported in a bulletin issued in December that, after a most careful field study extending over practically the whole summer, he was convinced that the action of the State was advisable under the circumstances and that the work is being carried on in a manner worthy of all praise.

#### THE SAN JOSE SCALE.

As stated in the last Annual Report, the actual investigations upon this insect conducted by the division were practically completed in 1896, the work from that point being taken up with activity by State organizations. The amount of work, however, which was done by State officers and organizations during the years 1896 and 1897 was so extensive and the results in some cases were so contradictory, that in

the spring of 1898 it was deemed desirable to publish a summary of the work accomplished which should be supplementary to previous publications by the division and should bring the status of the San Jose scale question down to date. Such a summary was prepared by the Entomologist and published in March, 1898.

#### THE MEXICAN COTTON-BOLL WEEVIL.

In the course of the Mexican work, referred to in a previous paragraph, efforts were made to discover parasites of this injurious insect in its native habitat which might be to advantage imported into Texas. This investigation was promised in the last Annual Report. No such parasites, however, were found. Some work was done in the field in Texas in the autumn of 1897 and more in the late spring of 1898 by a field agent of the division. The autumn work related to the spread of the species and the spring work to actual field remedies. It was shown, as predicted, that the insect has not yet spread beyond the region of the growth of volunteer cotton, and the remedial work has indicated that in addition to the cultural methods of control mentioned in previous publications by the Entomologist, much excellent work can be done in the spring by poisoning isolated stalks of volunteer cotton with a mixture of molasses and arsenic, so that early issuing weevils are killed and a greater or less amount of damage averted. The indisposition on the part of many planters to adopt the cultural methods heretofore recommended renders this poisoning work of greater value than it would otherwise be and offers a comparatively easy method of control to the small planters of a restricted region.

#### THE CHINCH BUG AND THE HESSIAN FLY.

During the year investigations have been made upon these two well-known and very injurious insects and a comprehensive bulletin upon each species has been completed and is now ready for the printer. By virtue of their great familiarity with the subjects and their fortunate location for the prosecution of such work, the investigation of the Hessian fly was intrusted to Prof. Herbert Osborn, of Ames, Iowa, and that upon the chinch bug to Prof. F. M. Webster, of Wooster, Ohio.

#### INJURIOUS GRASSHOPPERS.

As in previous years, a trip was made during the summer months of 1897 by a field agent of the division through the Western States most liable to be overrun by the Rocky Mountain locust, or Western grasshopper, for the purpose of gauging the actual damage and suggesting remedial work to farmers as well as for the more important purpose of being able to predict the probabilities of damage for the coming season. In the absence of Professor Bruner, of Nebraska, the field agent who had previously done this work for the division, his assistant, Mr. W. D. Hunter, was chosen for the work. He found that there was a general activity of the Rocky Mountain locust throughout its permanent breeding region, a greater activity, in fact, than for many years. He predicted the occurrence of the species during the summer of 1898 in South Dakota, Nebraska, and northern Kansas, but believed that the damage would be less noticeable than that done during 1897.

## THE PERIODICAL CICADA, OR SEVENTEEN-YEAR LOCUST.

The predicted occurrence in May and June, 1898, of two important broods of the periodical cicada induced the preparation of an elaborate bulletin upon this species, the work being intrusted to the First Assistant Entomologist. The task was accomplished with thoroughness, and the bulletin contains by far the best and most comprehensive account of this insect yet published.

## HOUSEHOLD INSECTS.

The preparation of Bulletin No. 4 of the division on the subject of "Household insects" attracted the attention of the office force to several important points connected with these insects which still required study, and a certain amount of this work has been carried on during the year. It may be worth while to mention that practical experiments, made on the grounds of the Department, have resulted in a noticeable diminution in the number of house flies in the Department buildings, and further, that an experiment upon mosquitoes on a large scale was undertaken during the spring of 1898 on Staten Island, New York, under the direction of this division, which promises good results.

## GENERAL WORK IN PROGRESS.

General investigations mentioned in previous reports upon shade-tree insects, stored-food insects, insects injurious to garden crops, and insects injurious to citrus trees and fruits have not yet been completed. The necessity for a close personal investigation of the life history of each of the species concerned makes progress in this work slow. The report upon insects injurious to citrus trees, promised two years ago, is still delayed by the serious failure in health of the assistant having charge of the work. He has been obliged to remove to Arizona for his health, and to lead, as far as possible, an outdoor life. He has greatly enriched the collections of the Department by this outdoor work and has made many observations of interest, but has not been able to continue the confining work of completing his report. Mention was made in the last report of a general popular bulletin, to be arranged in encyclopedic form, on the principal injurious insects of the United States. The necessity for abundance of illustrations in such a work has delayed its completion.

## TECHNICAL WORK.

No numbers of the technical series of bulletins have been published or completed during the year. The condition of the general printing fund necessitated a decision by the Secretary of Agriculture that purely technical publications should be paid from the funds of the office conducting the work, and in the case of this division the state of its funds was not such as to justify the use of any portion of them for printing.

## SENDING BENEFICIAL INSECTS ABROAD.

Attracted by the success obtained in this country in the practical use of the insect enemies of destructive species, applications have been received from several foreign countries during the year for supplies of beneficial insects, and especially *Novius cardinalis*, the Australian ladybird, which has done such notable work in California against the



white or fluted scale (*Icerya purchasi*). The State board of horticulture of California has conscientiously kept a supply of living specimens of several of the Australian species continuously breeding in jars in the office of the board for the purpose of supplying applicants in different parts of the State of California. On this account there has been no effort made to perpetuate living stock of these species by the Department, more especially on account of the danger of introducing into the East the scales on which they live and of which it would be necessary to have a supply for food. Through the kindness of the California board the Division of Entomology has been able to supply several of the foreign applicants. A most notable success has been achieved in one instance, while in the others similar results are to be expected. In portions of Portugal the citrus-growing industry was threatened with extinction by *Icerya purchasi*. Living specimens of *Novius cardinalis* were sent during the autumn and winter of 1897. A small proportion of them arrived in good condition, and the latest advices indicate that they reproduced so rapidly that they are now breeding by the millions and the scale insect is rapidly being destroyed. In the same way specimens of the same insect were sent to the School of Agriculture, Ghizeh, Egypt, for use against an allied species—*Icerya aegyptiacum*. The division was also able to secure the sending of specimens of *Cryptolaemus montrouzieri* from the State board of horticulture to the Island of Madeira for use against an injurious mealy bug, and a colony of the same ladybird was obtained through the kindness of Mr. Albert Koebele, an expert in the employment of the then Hawaiian Government, and transmitted to Guatemala for use against a mealy bug which is damaging the rich coffee plantations of that republic.

#### (b) EXPERIMENTAL WORK WITH REMEDIES.

The insecticide work carried out during the year was in the main a continuation of work already in progress, and consisted in the experimentation with various insecticides and methods of control of insect pests. A good deal of careful work was done with hydrocyanic-acid gas, particularly in the disinfection of large quantities of seeds received from abroad and distributed by the Department, and also in the disinfection of plants and nursery material from foreign sources, also procured by the Department for distribution. Other work with this gas has confirmed the results of previous years, demonstrating its great value, not only as a means against citrus insects, for which it has been almost exclusively employed, but also as a means of controlling scale insects on deciduous trees in the East. Experiments have also been conducted with arsenicals and various oil mixtures to determine their effects on plants in dormant condition and in foliage. The experiments continued from last year with the simple arsenite of copper have again fully demonstrated the value of this substance as an insecticide to be equal, if not superior, to Paris green, which costs twice as much. It is hoped that the dissemination of this information will lead to much saving to the farmers and fruit growers who have been in the habit of using Paris green.

During the months from August to November, inclusive, the First Assistant Entomologist was granted leave of absence to visit, at his own expense, the different stations in European countries, where entomological work is carried on similar to our own. Most of the countries of southern Europe were visited, and an acquaintance was



made with the men in charge; and the methods of controlling injurious insects in the Old World were carefully studied with the view to determine their value and applicability to our own country. The conditions of climate, forest growth, and methods of culture were also studied in their bearing on the abundance or absence of injurious insects and on methods of prevention of insect injury.

(c) DETERMINATION OF SPECIMENS SENT IN.

The work in this direction continues to be heavy and consumes a considerable amount of the time of four of the expert assistants who are specialists in different groups. About the same number of insects were named for experiment station entomologists as during the previous fiscal year.

(d) GENERAL INVESTIGATIONS OF THE LIFE HISTORIES OF INJURIOUS INSECTS.

During the fiscal year notes were recorded upon 514 species which had never before been studied in the insectary. The catalogue number of the biological series so studied reached on June 30, 1898, 8,139.

(e) WORK ON THE GEOGRAPHIC DISTRIBUTION OF THE INJURIOUS INSECTS OF THE UNITED STATES.

This work has been carried on through the year, but progress is slow. Additional circulars have been sent out to all persons in the United States whose assistance, through expert knowledge, is liable to be of value. Very many records have been mapped during the year, and with a number of species the distribution begins to be tolerably plain.

(f) BIBLIOGRAPHIC WORK.

Great progress has been made in this branch during the year. The bibliography of the more important articles on North American economic entomology has been completed from the close of the Henshaw Bibliography (June 30, 1888) down to the close of the calendar year 1896, and this portion has been published as Part VI of the Bibliography. It covers the period since the establishment of the State agricultural experiment stations, a period which has been rich in publications on this subject. Nearly 4,000 titles of articles upon American injurious insects are recorded in this work. In addition, a general current bibliography of works and articles on entomology has been kept up.

(g) PREPARATION OF CIRCULARS OF INFORMATION.

Nine of these circulars concerning insects of prime economic importance were published during the year. The demand for these circulars continues, and the series, which at this date numbers 36, including 5 which have been published since June 30, 1898, is beginning to have a marked effect on the amount of labor required in the general correspondence of the office.

(h) CORRESPONDENCE.

The correspondence of the office during the year has been larger than during any previous year in the history of the division. About

6,500 letters were written in answer to inquiries concerning injurious insects, and other inquiries were answered by means of circulars.

(i) MOUNTING AND PREPARATION OF SPECIMENS FOR PERMANENT PRESERVATION.

This branch of the work has been more onerous than usual. The time of two assistants has been constantly engaged in this preparation of specimens. Very valuable additions to the collection of the U. S. National Museum have in this way been made through the U. S. Department of Agriculture. The relations between the two institutions are such that the National Museum collections are as much a part of the equipment of this division as its own library and working material, the advantage of the fireproof museum building more than compensating for the distance between the offices.

(j) PUBLICATIONS.

On account of the fact that this branch of the work is covered in the report of the chief of the Division of Publications of the Department, it will suffice to state that in addition to the 9 circulars previously mentioned, there have been published 3 Farmers' Bulletins, 2 Year-book articles, 6 bulletins of the general series, and Part VI of the Bibliography, making a total of about 1,000 printed pages.

(k) THE EXHIBIT OF INSECTS FOR THE OMAHA EXPOSITION.

In the main the same exhibit was made at Omaha that was made at Nashville. It is a general collection illustrating the specific insects of certain crops classified in accordance with the crops. Insects of crops which are peculiarly Southern in their character were, however, excluded from the Omaha series, and other series, such as that illustrating the insects injurious to the sugar beet, were added, while others of prime importance to Western agriculture, such as insects injurious to live stock and to forage crops and grains, were elaborated.

(l) WORK IN APICULTURE.

The work in apiculture has included during the year the answering of numerous inquiries as to bee management, diseases and enemies of bees, the best races, the sources of information, etc. One bulletin, entitled "Bee keeping," was issued as Farmers' Bulletin No. 59. An extensive experiment in the outdoor wintering of bees was conducted and has given, with experiments and observations concerning honey-producing plants, valuable data for future publications on these special topics.

PROPOSED WORK FOR THE FISCAL YEAR 1899.

As explained in previous reports, it is impossible to anticipate special subjects for investigations which it may at any time become necessary to undertake. This condition of affairs was markedly illustrated the present season by a sudden increase of correspondence with regard to the cottony maple scale, an insect which occasionally more or less seriously damages maple shade trees. There had been

no general appearance of this insect in injurious numbers for many years until the present season, but suddenly with the beginning of the summer of 1898 the species made its appearance in alarming numbers over a large portion of the Northeastern United States, from New England to the Mississippi Valley, and it was soon ascertained that previous publications regarding its life history were incorrect in vital points, and a reinvestigation of the species was necessitated. This outbreak and needed investigation could by no means have been anticipated last year. The work in certain general directions, as indicated in previous sections of the report, will be prosecuted. Experimental work in apiculture, in the investigations of the insects affecting garden crops, shade trees, and stored grain, will be continued. Another investigation of injurious grasshoppers in the West will be made, together with autumn and spring investigations of the Mexican cotton-boll weevil for the purpose of ascertaining the spread of the species and of trying practical remedies on a large scale.

#### NEED OF INVESTIGATIONS IN THE WEST INDIES.

With the greatly increased commercial relations which will undoubtedly follow between this country and Puerto Rico and Cuba there will be immediate danger of the introduction of an indefinite number of insects injurious to agriculture. This danger will not exist in the case of Hawaii, owing to the admirable system of inspection which is carried on under the State board of horticulture of California at the port of San Francisco. Moreover, the Hawaiian Government has for some years employed an official entomologist, and the injurious insects of that archipelago are comparatively well known. Of the insects of Cuba and Puerto Rico, however, we are in comparative ignorance, and at least a preliminary investigation of the crop pests of these islands should be made at as early a date as possible. If funds for the purpose can be provided by Congress, I would urge that this work be undertaken with the beginning of the fiscal year 1899

#### SUGGESTIONS AS TO WORK FOR THE FISCAL YEAR 1900, FOR USE IN PREPARING ESTIMATES.

I wish to urge an additional appropriation of \$2,500 for the purpose of experimental investigations in apiculture. There has been a great demand for such work from the bee keepers of the country, and an outline plan of work promising valuable results, which has been drawn up by an expert in apiculture connected with the division, has convinced the writer that such an appropriation may be made to yield good results. I wish also to urge that an additional assistant at a salary of \$1,200 be provided for. In the work which is now going on and the plans in view for the future the office force is shorthanded.

In accordance with the reasons set forth above, I also recommend that Congress be asked for an additional appropriation of \$5,000 for the purpose of making a careful study of the insects injurious to agriculture which are liable to be introduced into this country from Cuba and Puerto Rico.





## REPORT OF THE ACTING CHIEF OF THE DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY,  
*Washington, D. C., September 1, 1898.*

SIR: I have the honor to submit herewith a review of the work of this division for the fiscal year ending June 30, 1898, and an outline of the investigations under way and planned for the current fiscal year.

Respectfully,

ALBERT F. WOODS,  
*Acting Chief.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

The principal work carried on during the year may be discussed under the following heads:

- (1) Diseases of truck and garden crops.
- (2) Work on citrus fruits and other subtropical plants.
- (3) Cereals and cereal diseases.
- (4) Diseases affecting fruits and other crops on the Pacific coast.
- (5) Diseases of pomaceous and allied fruits.
- (6) Diseases of the peach and plum.
- (7) Diseases affecting crops grown under glass.
- (8) Diseases of forest and shade trees.
- (9) Plant nutrition.
- (10) Plant breeding.
- (11) The herbarium.
- (12) Bibliographic work.
- (13) Preparation and publication of bulletins and papers.
- (14) Correspondence and lectures.

### DISEASES OF TRUCK AND GARDEN CROPS.

During the past few years a destructive disease of cabbages and other allied plants, known as black or brown rot, has occasioned great loss to farmers and market gardeners. The division has clearly demonstrated the bacterial nature of the disease and worked out the life history of the organism causing it. The results of the work were published in Farmers' Bulletin No. 68, in which a method of avoiding the rot and preventing its spread is also described.

Considerable work on sugar-beet diseases was done in our laboratories here and in California. Studies of the *Alternaria*, or leaf-spot

disease of muskmelons, and of a bacterial disease of cucurbits were continued. Preliminary experiments indicate that the former may be easily prevented by spraying with Bordeaux mixture.

A new disease of sweet potatoes, resembling scab of the Irish potato, has been discovered, and experiments were instituted with a view to finding a remedy. An experiment in the treatment of celery-leaf blight, carried out at Garrett Park, Md., demonstrated that this disease can be easily controlled by spraying with Bordeaux mixture. Ammoniacal copper carbonate solution was also tried, but did not prove satisfactory.

#### WORK ON CITRUS FRUITS AND OTHER SUBTROPICAL PLANTS.

The plan of the work in Florida on citrus fruits and other subtropical as well as tropical plants was changed materially during the year, as suggested in the report of last year. In November the two assistants up to that time stationed in Florida returned to Washington, where they are permanently located. A small laboratory and a garden of 6 acres were secured at Miami, Fla., free of expense to the Department, and there it is planned to continue the field work. All the experimental plants, hybrids, etc., have already been moved to the garden. Miami is located in the extreme southern part of Florida, where there is little danger from frosts, and on this account the garden will be a great aid in the breeding and improvement experiments with the orange, pineapple, guava, etc., begun during the year and now under way.

The work on the various orange and lemon diseases was pushed as rapidly as possible during the year. Considerable attention was given to a further study of the treatments for the sooty mold, a fungous disease which follows attacks of the mealy wing, or white fly. The work showed conclusively that the two parasitic fungous diseases attacking the mealy wing and described in Bulletin No. 13 of this division can be spread artificially and may thus be used as a means of combatting this much-feared disease. Efforts were therefore made to introduce these friendly fungi into the various sections of the State where the mealy wing and sooty mold are abundant.

Studies of blight, die back, and certain minor diseases of the orange, lemon, and grape fruit were continued. Many observations were made on the diseases of the pineapple, particularly the blight, which is the most serious. This malady appears to be caused by a fungus which attacks the roots and base of the plant, and may be gotten rid of, at least in many cases, by first cutting off the base of the plant above the diseased portion and then transplanting. Notes and observations were also made on diseases of the mango, guava, and Avocado pear, all of which are extensively grown in south Florida. A very destructive coffee disease, prevalent in Central America and South America, was investigated and steps were taken to prevent its being introduced into Hawaii.

#### CEREALS AND CEREAL DISEASES.

The field experiments carried on in cooperation with the Kansas State Experiment Station to test the rust resistance of various home and foreign varieties of wheat and their adaptability to the different wheat-producing regions of the country were concluded. As suggested in the last report, this test of varieties under severe conditions

showed with considerable certainty which are best adapted to this country and what countries can be drawn on for new sorts with the greatest prospect of success. The collection of data regarding the wheat plant under various conditions of climate and culture in different parts of the world was continued, and much valuable information which will aid in the importation and testing of new varieties was acquired.

The laboratory and field studies of the life history of the various rusts of cereals and other plants were continued, and the relative resistance to their respective rust parasites was determined in the case of the different varieties of wheat, rye, oats, and barley. A technical bulletin was prepared to aid experiment-station workers along this line, and will soon be ready for publication. A further investigation of methods for preventing cereal smuts was made during the year and the results were published as Farmers' Bulletin No. 75.

#### DISEASES AFFECTING FRUITS AND OTHER CROPS ON THE PACIFIC COAST.

At the Pacific coast laboratory the work during the year was along several lines, and the assistant in charge was freely called upon for information by fruit growers from all portions of the coast. A large number of diseased plants and fruits were received and their examination and the resulting correspondence necessarily required considerable time. It is believed, however, that this feature of the work has resulted in much benefit to the fruit industry of the coast. On account of the number of bacterial diseases under investigation it became necessary to refit the bacteriological laboratory with the facilities required for closer lines of research. This consumed considerable time during the summer.

A new and destructive disease of bulbs was investigated, its bacterial nature established, the mode of infection learned, and a practical means of prevention recommended. A serious bacterial disease of olives, unfortunately introduced from Europe, was studied with a view to finding some practical means of prevention, and plans were made for experiments to determine a satisfactory mode of treatment.

A bacterial walnut disease, the cause and treatment of which have been worked out within the past two years, has been under investigation in both laboratory and field. Several new facts of importance were learned, such as the common way in which the organism causing the disease passes the winter, the manner of rapid spring infection of the trees, and the chemical action of the germ upon the walnut tissues, by means of which it effects its injurious results. Additional spraying experiments in the orchard have also been conducted for the control of the disease, and the facts relative to the best means of prevention thus far learned have been given to the growers through the press and the associations of the coast.

Among other maladies studied were several fungous diseases of the lemon and one of the fruit of the olive. A new disease of corn was also investigated. The growing importance of sugar-beet culture on the Pacific coast, especially in California, has made it desirable to gather facts respecting the more serious diseases of this plant, and a beginning was made in this direction. Such advancement in the preparation of manuscript for publication as time would allow was made during the year.



## DISEASES OF POMACEOUS AND ALLIED FRUITS.

During the past year additional points in the life history of the pear-blight germ were determined, and the work of preparing a bulletin giving a complete description of the disease and its remedy was nearly completed. A new apple-twigg disease was discovered and its investigation begun. Notes, specimens, drawings, photographs, etc., were collected and classified preparatory to writing a bulletin covering all pomaceous-fruit diseases known to occur in this country.

## DISEASES OF THE PEACH AND PLUM.

The treatment for peach-leaf curl in the Pacific coast States is rapidly growing in favor on account of its remarkable success, and steps have been taken to introduce the treatment into Eastern orchards. A bulletin on the subject is in course of preparation.

A new disease of the Japan plum, from Texas, was found, and is believed to be of bacterial origin. Another obscure disease of plums was finally traced to the peach-bud mite. A circular on the subject was prepared and will be published in cooperation with the Division of Entomology. Two kinds of root rot of peach and plum trees were found to be doing serious damage in the South.

## DISEASES AFFECTING CROPS GROWN UNDER GLASS.

The cultivation of crops under glass is a rapidly growing and important industry. It is estimated that from \$75,000,000 to \$100,000,000 is invested in this way. The loss from diseases of various kinds is often enormous, falling heavily upon individual growers. An unknown rose disease, occasioning much loss, was investigated and its cause found to be a fungus. The effect of hydrocyanic-acid gas on various greenhouse crops was thoroughly investigated, and a simple, cheap, and safe method of using it determined and successfully applied in treating coleus, ferns, violets, and carnations for various insect pests. Cooperative work with the Division of Entomology was also begun along this line.

Much progress was made in the study of the various diseases affecting the English violet, carnations, hyacinths, tomatoes, cucumbers, and other forcing-house crops. Special attention was given to the germ causing the hyacinth disease, because of its close relation to the one causing the black rot of cabbage. Many interesting facts which will throw light upon this whole group of organisms were learned.

## DISEASES OF FOREST AND SHADE TREES.

Since the publication of the article on "Diseases of shade and ornamental trees" in the Yearbook of the Department for 1896, many requests for further information, and also numerous specimens for determination, have been received. Work on a new and destructive disease of Norway maple was continued, and it is now believed that the cause of the trouble has been found. The collecting of data in regard to the diseases of forest trees has also been continued and work has been pushed as rapidly as limited time and funds would permit.



## PLANT NUTRITION.

The experiments in plant feeding have been continued with roses, carnations, violets, chrysanthemums, and lilies, and also with tomatoes—an important forcing-house crop. The danger of bringing on root diseases by over-feeding was one of the most important points determined. To obtain more light on certain fundamental problems in plant nutrition, and also to collect information as to certain methods which it is desirable to use here, an assistant was sent to make the necessary investigations in the laboratories in Leipsic, Germany.

## PLANT BREEDING.

For several years this division has given considerable attention to the general subject of plant breeding. We were first led to a consideration of the improvement of plants by the satisfactory demonstration that the most efficient means of combating certain plant diseases is to secure sorts which through careful selection have been rendered so vigorous and capable of resisting disease as to be immune. This soon led to the consideration of the subject from the broader standpoint of securing improved sorts resistant to disease, and which will yield more and better fruit and be better suited to the soil and climatic conditions existing in different regions.

A paper on "Hybrids and their utilization in plant breeding" was prepared and published in the Yearbook for 1897. Although a general treatise on the subject, the article contains much original matter.

## CITRUS FRUITS.

Hybridization experiments with citrus fruits were begun in 1893 and have been continued to some extent ever since. From crosses made in 1893 and 1894 sixty-four hybrid orange trees were secured, and they are now growing in south Florida. Buds from each have been inserted on mature trees and will probably fruit next year. Crosses made in the spring of 1897 have yielded 883 hybrid trees, which up to the present time have been growing in the Department greenhouses. In the spring of 1898 four hundred and seventy-nine more citrus crosses were made, but it is not yet known what percentage of these will mature fruit.

At present the principal problem in citrus breeding is to secure a hardy orange, which will successfully resist the severe freezes that cause such serious havoc in Florida, Louisiana, and California. The experiments so far made by the division have shown conclusively that the common orange may be successfully hybridized with the so-called trifoliate orange, a hardy sort of poor quality, which can be grown as far north as Philadelphia. This opens up important possibilities of improvement in the hardiness of the fruit. Judging from results obtained with other fruits, there is every reason to believe that it will be possible to secure a hybrid sort having to a considerable degree the hardiness of the trifoliate orange and the fruit characters of the common orange. The same may be possible also in the case of the lemon, grape fruit, lime, etc., and in case of success would mean a complete revolution and great extension of these industries in the United States. The importance of securing a common orange of good quality, with the loose, easily removable rind of the mandarin and tangerine oranges, is obvious, and a special effort will be made with

this end in view. Hybrids have also been made with a view to securing blight-resistant sorts and sorts showing certain minor improvements.

#### PINEAPPLES.

In 1896 a few pineapple crosses were made to determine whether seeds could be produced by artificial cross fertilization. The results were affirmative, a number of perfect seeds, which gave several plants, being produced. Last year 693 crosses were made, and the seeds obtained from these gave 259 seedlings, which are now growing in the Department greenhouses. In the spring of 1898 four hundred and sixty-five more crosses were made, but it is not yet known what percentage of these will produce seeds. In the case of pineapples it is hoped to secure sorts with large fruits, of good quality, and good shippers, and which will be resistant to disease, especially the pineapple blight.

#### GUAVAS.

Experiments were undertaken with a view to reduce the number of seeds in the guava—one of the best known and most highly appreciated of the tropical fruits. If a sort can be secured having a sufficiently thick flesh to allow the peeling and coring of the fruit by machinery, an important industry in evaporating guavas (which make a very superior dried fruit) would doubtless spring up.

#### PEARS.

The important work of crossing the Oriental hybrid pears with the finest varieties of the European type was begun. One hundred and sixteen crosses were made, resulting in 53 fruits, from which it is expected a large number of seedlings will be obtained. The object of this work is to obtain a variety possessing the great vegetative vigor and disease resistance of the Orientals and the high quality of fruit of the tender European sorts. It is confidently expected that this may be accomplished by making a sufficient number of crosses.

#### GRAPES.

Many million dollars are annually lost in California and Arizona from a grape disease known as coulure, or falling of the young flowers and fruit. A study of the trouble has shown it to be due mainly to unfavorable climatic conditions at the time when the first crop of grapes is in bloom.

The great tenderness of the fine raisin varieties, Muscat of Alexandria and Muscatel Gordo Blanco, causes them to be very susceptible to injury. To overcome this weakness the two varieties mentioned have been crossed with Malaga, an exceedingly thrifty grower, very hardy, resistant to disease, and a good raisin grape, though not equal to the Muscat or Muscatel Gordo Blanco. About 20,000 crosses were made. The new seedlings are now several years old. When they come to maturity those having the hardiness of the Malaga and the fruiting qualities of the finer varieties will be selected.

#### WHEAT AND OTHER CROPS.

Similar lines of work in breeding wheats resistant to rust and for other desirable qualities were instituted. Work was also started in

selection and breeding of the Bermuda lily with a view to getting a more resistant bulb of earlier maturity. A large number of carnations were crossed to get better and hardier varieties. In the case of the English violet, selection experiments on a large scale have been going on for several years, and as a result plants have been secured which are more resistant to spot and other diseases and yield 50 per cent more flowers.

#### THE HERBARIUM.

Large numbers of specimens of diseased plants are constantly coming in from farmers, fruit growers, experiment-station workers and others for identification and remedy, and such of these as are of value are preserved in the herbarium for use in identifying new material and for distribution to the experiment stations. About 12,000 specimens, representing 600 different species of fungi, are now almost ready to be sent out.

#### BIBLIOGRAPHIC WORK.

The indexing and abstracting of important literature on plant pathology and allied subjects were carried on as far as limited time and help would permit, but to be valuable such work should be kept up to date. Indexes of this kind save much time in answering correspondence and in conducting investigations.

#### PREPARATION AND PUBLICATION OF BULLETINS AND PAPERS.

Two bulletins, two Farmers' Bulletins, and two papers for the Year-book for 1897 were prepared and published. A bulletin on cereal rusts of the United States was prepared and is now ready for publication, and a bulletin each on peach-leaf curl and pear blight are nearly completed.

#### CORRESPONDENCE AND LECTURES.

The correspondence, as heretofore, occupied much of the time of the entire force. About 6,000 letters, including the correspondence of the assistants in Florida and California, were answered. Many of these required the work of days and even weeks in making microscopical and cultural study of material sent for examination before they could be answered satisfactorily, while in the case of others the information desired could be furnished by sending bulletins or circulars. In most cases, however, letters of explanation are necessary, and although the preparation of so many requires much time, it is believed the good done in reaching the people in this way fully warrants the effort.

Seven lectures were delivered in different parts of the country before horticultural societies, two before farmers' institutes, two before tobacco growers' associations, and a number before various scientific societies.

#### WORK UNDER WAY AND PLANNED FOR THE CURRENT YEAR.

Many of the problems and lines of work which engaged the attention of the division during the fiscal year ending June 30, 1898, necessarily extend into the current fiscal year.



The work on bacterial wilt of cucumbers, muskmelons, pumpkins, squashes, and other cucurbits will be completed and a bulletin on the subject prepared. The work on the leaf spot or *Alternaria* disease of muskmelons will also be completed and the results prepared for publication. The investigation of the fungous soil disease of watermelons and cotton, and also of an important bacterial disease of tomato, will be continued.

In the investigations of citrus diseases in Florida it is planned to limit the work mainly to sooty mold and die back. In the study of sooty mold further experiments should be made, in cooperation with the Division of Entomology, to demonstrate the effectiveness of the entomogenous fungi attacking the mealy wing, and the fungi should be introduced into all orange regions where the mealy wing exists. The work on die back will be directed mainly with a view to determining the fundamental cause of the disease. Observations made by the Division of Soils on certain die-back soils indicate that the disease may be produced by an organic acid. Arrangements are being made for a series of culture experiments to test this theory.

One of the assistants formerly located in Florida has been detailed to the Section of Seed and Plant Introduction for the collection of valuable plants and fruits in the Mediterranean countries for introduction into the United States. He will, also, as far as time permits, make observations on the diseases affecting crops in these countries and the methods of culture pursued, all of which will be of great service in future work.

The study of the life history of the rusts of cereals will be continued, special attention to be given to the black-stem rusts of wheat and oats, which are by far the most destructive. The assistant in charge of this work has been detailed for six months to the Section of Seed and Plant Introduction, and is now in Russia collecting the most valuable cereals and forage plants to be found there for introduction into the United States. He will also collect as much information as possible in regard to cereal and other crop diseases prevalent in Russia and data relative to the general agricultural conditions of the country.

It is proposed to institute experiments on the Pacific coast in the treatment of the apple canker of Oregon and Washington. The methods of treatment of this serious disease which have already been recommended are reported to be successful in the hands of skilled workers, but it is necessary to place before those less familiar with such work an object lesson which shall be as striking as possible, and in order to do this the assistant stationed on the Pacific coast will have to personally conduct the experiments. A like need is felt in the fruit region of northern California in the treatment of the shot-hole fungus of the apricot and a new disease of somewhat similar nature affecting the young growth of the peach. The experimental work in the treatment of olive tuberculosis is also to be undertaken, if possible, during the year. Continued field work will be necessary on walnut bacteriosis, as well as upon two new diseases, one of the fruit of the olive and one of the orange. During the year it will also be necessary to look after the extensive grape-crossing experiments in progress at Hanford, Cal.

Besides the investigations of plant diseases now in progress in the Pacific coast States, and such as may attract the attention of growers during the year, the assistant in charge of the laboratory there will give such time as may be available to the study of the chemical action



of microorganisms upon their hosts, along the same lines as are followed in the laboratories here. It is believed that this class of work will enable us to explain many pathological phenomena of plants not explainable by histological methods, and will throw much needed light on the true nature of some of our most serious and at present most obscure plant diseases. It is planned by the assistant to complete during the year the manuscript for several bulletins on work already well in hand.

It is also our purpose to personally supervise the treatment of several orchards for pear blight, in order to demonstrate in a striking manner the fact that the disease may be prevented. The work on other diseases of pomaceous fruits will be continued.

The work on a widespread disease of peach, plum, and prune, known as gummosis, will be continued, and a preliminary investigation will be made of a new and destructive disease known as "little peach," which has appeared in Michigan. It is hoped that some work may be done on peach rot and a number of other destructive diseases of the peach.

The work on diseases affecting crops grown under glass will be continued, special attention to be given to tomatoes, cucumbers, English violets, carnations, roses, and chrysanthemums. It is hoped to prepare during the year a bulletin on the more important violet diseases and methods of culture of the crop.

A cooperative experiment has been arranged with the Division of Soils for the treatment of the root and leaf diseases of Norway maple. Many of these valuable shade trees are being killed by root asphyxiation and acid soils, and it is believed that this may be at least partially remedied. Work on other diseases affecting forest and shade trees will be continued.

The problems of plant nutrition and fermentation will receive considerable attention during the year. Special attention will be given to the fermentation and curing of tobacco.

Much attention will necessarily be given to plant breeding. The improvement of citrus fruits will be continued principally along the lines already started, special attention to be given to the production of hardy varieties by hybridizing them with the hardy trifoliolate and the loose-skinned oranges of the mandarin type. Pineapple-hybridization experiments will be continued along the lines already mentioned, and it is planned to start selection experiments also, mainly with a view to securing more vigorous hardy strains of certain of the best sorts which will be resistant to blight. The selection experiments begun two years ago with a view to reducing the number of seeds in the guava will be continued, as will the work begun in breeding hardy, disease-resistant, high-quality pears, and the experiments to secure rust-resistant varieties of wheat. It is the intention to institute as soon as possible careful selection and hybridization experiments with a view to obtaining more productive and vigorous wheats, which will yield a larger per cent of gluten.

Increasing the yield of the common sorts of corn by careful and systematic selection is believed to be a matter of exceptional importance, and it is thought that greatly improved strains can be secured by instituting a method of selection similar to that used by Sea-Island cotton growers. It is also planned to experiment, to a limited extent, on the increase of yield as a result of crossing certain sorts—a factor of great promise.

Several important improvements in the peach have been under consideration, and it is planned to start selection and hybridization experiments with this fruit next spring. The work of securing a hardy high-quality raisin grape, resistant to coulure, will be continued. The introduction of new plants from foreign countries will give special opportunities for work in plant breeding. This work of introducing plants, undertaken by the Department, has made it necessary for this division to collect and classify all obtainable information relative to new diseases likely to be brought into the United States through this channel. This work will be pushed as rapidly as possible, and all plants coming in will be inspected as thoroughly as possible for fungous diseases, under the supervision of this division.

**REPORT OF THE ACTING CHIEF OF THE DIVISION OF  
BIOLOGICAL SURVEY.**

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF BIOLOGICAL SURVEY,  
*Washington, D. C., September 1, 1898.*

SIR: I have the honor to submit herewith a report of the work of the Biological Survey for the fiscal year ending June 30, 1898.

Respectfully,

T. S. PALMER,  
*Acting Chief, Biological Survey.*

Hon. JAMES WILSON, *Secretary.*

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**WORK OF THE YEAR.**

**LIFE ZONES OF THE UNITED STATES.**

The Biological Survey has undertaken to map the natural life zones of the United States and to furnish information which will aid the farmer and horticulturist in the selection of crops best adapted to their localities. The boundaries of these life zones are determined by a detailed study of the distribution of animals and plants, for it is believed that areas inhabited by native species coincide with those adapted for certain fruits, cereals, and breeds of domesticated animals.

The fiscal year ending June 30, 1898, marks an important advance in the work of this office by the completion of the first detailed report showing the particular varieties of crops adapted to the several zones. Investigations on geographic distribution have been carried on since the organization of the division, but progress has been necessarily slow. The first step (begun with the establishment of the Division of Ornithology and Mammalogy) consisted in systematically collecting and tabulating all the available information respecting the distribution of mammals and birds. The data thus obtained were platted on maps and subsequently amplified by observations made in the field.

In 1889 a careful survey was undertaken of an area comprising 5,000 square miles in the San Francisco Mountain region of northern Arizona, a region which offered exceptional advantages for studying geographic distribution of species. Among the most important results of this experimental survey may be mentioned the recognition of seven life zones on the continent of North America, and the publication of a provisional biogeographic map showing their approximate boundaries. The publication of the report on the San Francisco Mountain region may fairly be said to mark the beginning of the second stage of the work.

In the following year Congress removed the restriction confining the investigations to the geographic distribution of mammals and birds, thus enlarging the scope of the work and in effect establishing a

Biological Survey, although the change in name (from Division of Ornithology and Mammalogy) was not made until July 1, 1896. In the meantime systematic surveys had been made of southern Idaho (1890), southern California and Nevada (1891), and portions of Oregon and Washington. The information thus brought together, in addition to data already accumulated by the tabulation of records on the distribution of species, resulted in the publication of two new editions of the biogeographic map, one in 1892 and the other in 1893. The third map, which appeared in the Annual Report of the Secretary of Agriculture for 1893, was accompanied by a brief statement concerning the principal crops adapted to each of the life zones.

The principal life areas having been mapped, and the more important species of mammals, birds, and trees characteristic of each area determined, it remained to ascertain the boundaries with sufficient detail to permit the publication of larger scale maps and to investigate the varieties of the several crops best adapted to each area.

#### CEREAL INVESTIGATIONS.

Early in 1897 the third stage of the work was begun by an investigation of the geographic distribution of cereals, which was intrusted to Prof. C. S. Plumb, director of the Agricultural Experiment Station of Indiana. As already stated in the Annual Report for last year, Professor Plumb collected information from more than a thousand grain growers regarding the varieties of corn, wheat, and oats cultivated most successfully in the United States and Canada. The data for each variety were tabulated separately and maps prepared showing the points from which reports had been received. It was found that the profitable cultivation of most varieties of cereals was restricted to two, and in some cases to a single one, of the life zones. This report was received last year, but its publication was delayed, pending the preparation of maps necessary to illustrate the text. The report is now in the hands of the Public Printer, and will be issued as Bulletin No. 11.

The revised edition of the map of life zones of the United States mentioned in the last Annual Report has been prepared from new data furnished by recent field work and is corrected up to the close of 1897. The publication of this map and the report on cereals furnished an opportunity for explaining more fully than had yet been done the bearing of the work of the division on practical agriculture. A special bulletin, No. 10, entitled "Life zones and crop zones of the United States," was accordingly prepared, in which the subject was treated under the following heads: (a) "Relation of the Biological Survey to agriculture;" (b) "Life zones of the United States;" (c) "Laws of temperature control of the geographic distribution of animals and plants;" and, (d) "Crop tables," including lists of the principal varieties of grain and fruit adapted to each zone.

#### PUBLICATIONS.

The publications issued during the year include the map of the life zones of the United States already mentioned, two articles in the Yearbook of the Department for 1897, one number of North American Fauna (No. 13), and a revised edition of Bulletin No. 8 on "Jack rabbits of the United States." Reprints were also issued of Farmers' Bulletin 54 on "Common birds in relation to agriculture," Bulletin 8 on "Jack rabbits," and Circular No. 20 on "Bird day in the schools."



One of the articles in the Yearbook was devoted to the work of the survey, detailing its methods, objects, main results accomplished, and the practical value of its investigations to the farmer. The other paper, entitled "Birds that injure grain," consisted of a brief account of the injuries to cereal crops caused by blackbirds, grackles, crows, cowbirds, and quails. Fauna No. 13, a technical report issued in a small edition, contained a critical revision of the bats of the family *Vespertilionidae*, a group which includes most of the species in North America. The bulletin on jack rabbits was originally published in 1896 and had been out of print for some months. In the interval since its publication much new information had been accumulated, which was incorporated in the revised edition issued in December, 1897, and again reprinted in March, 1898.

The following bulletins were prepared and submitted for publication during the fiscal year: No. 9, "Cuckoos and shrikes in their relation to agriculture;" No. 10, "Life zones and crop zones of the United States," and No. 11, "The geographic distribution of cereals in North America." These bulletins are so near completion that their early appearance may be looked for.

#### GEOGRAPHIC DISTRIBUTION.

During the fiscal year ending June 30, 1898, field work was carried on in the four Pacific States of Washington, Oregon, California, Nevada, and in northern Mexico and southern British Columbia. The determination of the boundaries of the life zones in the northwest, begun in 1896, was continued throughout last season, and four field parties were engaged in Washington and Oregon. Mount Rainier, parts of the Cascade Range, the Olympic Mountains, the coast region north of Grays Harbor, the north central part of the State along the international boundary, and the Blue and Wallowa mountains in northeastern Oregon were all worked with more or less detail. In the spring of 1898 a reconnaissance was made in central and eastern Nevada. This was extended westward across northeastern California to Mount Shasta and the adjacent region. Progress has been made in working up the material collected in Oregon and Washington during the last two seasons, and the report will be prepared for press as soon as practicable.

#### ECONOMIC RELATIONS OF MAMMALS AND BIRDS.

Investigations of the economic relations of particular mammals and birds were continued throughout the year, and about 2,300 stomachs of birds were examined in the laboratory. These stomachs may be arranged in the following groups:

Sparrows .....	1,353
Swallows .....	265
Woodpeckers .....	259
Flycatchers .....	164
Cuckoos .....	136
Blackbirds .....	84
Miscellaneous .....	68
Total .....	2,329

Special attention was paid to several beneficial birds, particularly those which feed on hairy caterpillars and weed seed. Comparatively few species beside our native cuckoos eat hairy caterpillars, but a

cuckoo has been known to destroy an entire colony of these insects at a single meal, and the abundance of cuckoos in certain localities is reported to be dependent to a certain extent upon the presence of hairy caterpillars. A careful study of the food habits of cuckoos was undertaken, including an examination of all the available stomachs (155), and the results prepared for publication. The investigation on the food of the shrikes was completed and the report carefully revised. These two reports will appear together as Bulletin No. 9 of the division series.

Several native sparrows are efficient agents in the destruction of weeds, since they devour immense quantities of weed seed during winter and early spring when other food is scarce. This subject merits careful study, as the value of these birds has not been generally recognized. Twenty-five hundred stomachs of native sparrows representing about thirty species and subspecies have already been examined in the laboratory, and these examinations have been supplemented to some extent by field observations. While the work is well under way, much remains to be done before it can be completed and the report prepared for publication.

Many of the questions which arise in studying the food habits of birds can not be settled by an examination of stomachs in the laboratory. It is necessary to know something more than the fact that a bird was killed at a certain season in a field of grain, because the abundance or scarcity of insects and seeds in the neighborhood may determine largely whether the bird was attracted to cultivated fields merely because of failure of its regular supply of food. Field work has therefore received more attention than usual this year, and an experimental study of the habits of certain birds in a limited area has been begun. A tract of land specially adapted for the purpose on account of diversity in crops was selected for observation near the city of Washington. The fields have been visited at different seasons, the birds carefully observed, and material collected from time to time to show the benefit or injury done to the crops.

The Iowa Ornithological Association has undertaken a comprehensive study of the birds of its State and has requested assistance in working up the material collected to illustrate the food habits of the various species. All the bird stomachs obtained by members of the association are forwarded to the Department, and much desirable material has been secured in this way, the number of stomachs received during the spring of 1898 aggregating 240.

#### IDENTIFICATION OF SPECIMENS.

As in former years, large numbers of specimens have been received for identification. While this part of the work consumes a good deal of time, correspondents are always encouraged to send in specimens about which they are in doubt, since these specimens often increase the value of accompanying notes and reports. The work also has an educational value, since it tends to a more general diffusion of knowledge of our native species and stimulates the study of their habits and life histories.

#### ROUTINE WORK.

Much of the time of the office force is necessarily devoted to routine work. About 2,700 letters were received during the year, many of them accompanied by reports, schedules, and notes, which were

examined and filed for future reference. Some of this correspondence relates to reports of the division and can be answered by circulars, but the larger part consists of inquiries concerning mammals and birds, requiring special replies, which often necessitate the expenditure of considerable time in preparation. About 2,000 letters were written and several hundred schedules distributed to correspondents; about 300 packages were received and 650 sent out. Other regular work consists in the arrangement of reports and information received from field naturalists and correspondents, care of collections, unpacking and repacking specimens received for identification, furnishing supplies to field naturalists, preparation of reports and bulletins for publication, and of reference lists useful in the work of the division.

#### **PLANS FOR THE FISCAL YEAR ENDING JUNE 30, 1899.**

Since the work already outlined for the Biological Survey will require much time for completion, the plans for a single year relate to details rather than to change in character or methods of investigation. The work for 1898-99, therefore, will consist mainly in a continuance of investigations now under way, which will be pushed to completion as rapidly as practicable.

The principal field work during the summer of 1898 will be done in northern California, in the region from Mount Shasta and Lassen Peak to the coast. This area is immediately south of the region covered in 1896 and 1897, and the work this season is expected to include the southern extension of the northwest coast fauna in California, thus continuing the work previously done in Oregon and Washington and furnishing data necessary for the completion of the report. The work of the present season also includes the running of a number of zone lines in other parts of California.

Investigations on the native sparrows, flycatchers, swallows, and other useful birds will be continued in the laboratory. The plans for the year contemplate supplementary field investigations in Maryland and one or two of the New England States, including studies of the food habits of birds in regions infested with such insect pests as the gipsy moth, army worm, and cutworm.

#### **PLANS AND ESTIMATES FOR FUTURE WORK.**

As the work of the Biological Survey becomes more generally known and better understood the demands for information, maps, and reports increase far more rapidly than the means for meeting them. Requests are frequently received for biological maps of certain States or areas, for zone maps on a larger scale than those yet published, and for maps of the distribution of particular species of mammals or birds. Maps of the life zones of the United States are sought, not only by agriculturists, but by teachers and others who wish them for purposes of instruction or reference. Several of the States have in contemplation or have already inaugurated local biological surveys, and have appealed to the Department for assistance or cooperation in this work. These surveys are greatly needed in several sections of the United States, and in some cases it would be desirable for the Department to assist in carrying them on. Demands like these from the general public, from experiment stations, and from State authorities are worthy of careful consideration, and some provision should



be made for meeting them in the near future. The present appropriations are insufficient for the purpose, for, as already shown, the investigations have increased considerably in the last decade, while the appropriations have remained unchanged for several years. The division has no funds available for printing expensive large-scale maps; it has been obliged thus far to decline every request for cooperation in State surveys, and has necessarily confined itself closely to the work already outlined.

One of the most important investigations demanding attention is a thorough study of the fauna and flora of the tropical region which lies along our southern border and enters the United States at several points. Such an investigation should cover a sufficiently wide area to ascertain the characteristic features of the region, including its topography, fauna, and flora, and particularly the crops which are or may be most profitably cultivated. The subject is of special importance at this time from the fact that the territory recently annexed by the United States lies entirely within the tropics. Moreover, the question of what semitropical or tropical products can now be profitably grown in Florida and the Gulf States, in competition with those from our island possessions, is likely to be a very important and practical one in several of the Southern States. In view of these facts, therefore, I desire to renew the recommendation that an increase of \$5,000 be made in the lump fund for biological investigations. This increase would enable the division to publish more maps, to cooperate in State surveys, and to undertake a thorough investigation of the fauna and flora of the tropical region; in short, to carry out more fully the work assigned to it by Congress.



## REPORT OF THE CHIEF OF THE DIVISION OF PUBLICATIONS.

U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF PUBLICATIONS,  
*Washington, D. C., September 3, 1898.*

SIR: I have the honor to submit for your information and consideration a report on the work of this division for the fiscal year ended June 30, 1898, together with some recommendations in regard to the future work and estimates for carrying it on during the fiscal year ending June 30, 1900.

Respectfully,

GEO. WM. HILL,  
*Chief.*

Hon. JAMES WILSON, *Secretary.*

### WORK OF THE YEAR.

The work of this division does not differ materially one year from another except in the increase of the manifold duties and responsibilities devolving upon it. This increase is due to the rapid growth in the publication work of the Department and to the consequent enlargement of the facilities for handling and distributing the printed documents. The divisional force has increased from 4 in 1890, the year it was first fully organized, to over 90 in 1898, and now comprises editorial clerks, proof readers, artists, engravers, typewriters, stenographers, bookkeepers, and laborers.

### PUBLICATIONS EDITED AND SUPERVISED.

During the fiscal year ended June 30, 1898, there were issued by the Department of Agriculture 501 publications, as follows:

#### *Publications supervised.*

Chargeable to regular fund.....	276
Chargeable to divisional funds.....	6
Chargeable to Farmers' Bulletin fund.....	95
Printed at Weather Bureau.....	113
Printed as Executive documents.....	11
Total.....	501

With the exception of the publications of the Weather Bureau, 121 in number, the editing and supervising of these publications were done in this division.

This shows an increase of 77 publications compared with the number handled last year. Of the whole number, 291 were original publications, aggregating 10,628 printed pages, and 210 were reprints,

aggregating 6,736 printed pages. The total number of printed pages, consequently, aggregated 17,365; the total number of copies of all publications printed during the year amounted to 6,280,365. The total number of copies printed is slightly less than last year. This is due principally to some modifications in the publishing methods of the Division of Statistics, which reduced the actual number of copies of all publications issued by that division, by comparison with the previous year, by 776,500; and also to a reduction in the total number of Farmers' Bulletins, by comparison with the previous year, of 217,000 copies. This reduction will be explained later when treating of the subject of Farmers' Bulletins in detail.

A list of the publications issued during the year is appended to this report, the bulletins, circulars, etc., being arranged under the bureaus, offices, and divisions to which they belong. (See Appendix A.)

It is interesting to note the steady increase in the publications of the Department during the past five or six years. I therefore subjoin a statement showing the number of publications and the total number of copies of all publications of this Department issued during the fiscal years 1893 to 1898, inclusive:

*Publications issued during the years 1893-1898.*

Year.	Publica- tions.	Total number copies.
1893 .....	210	2,689,084
1894 .....	205	3,169,310
1895 .....	254	4,100,660
1896 .....	376	6,561,700
1897 .....	424	6,541,210
1898 .....	501	6,280,365
Total .....	1,970	29,342,329

This increase has been attained in a measure by the publication of numerous small bulletins issued in large editions. Even with the increased number of copies thus obtained, it has not been possible even approximately to comply with the demand for the popular publications, nor can it be met save by an increase in the printing fund.

SOME DETAILS IN REGARD TO THE PRINTING.

The printing for the Department is done at the Government Printing Office, at the branch office in the Department building under the supervision of the Government Printing Office, and at the printing office of the Weather Bureau. The number of requisitions issued upon the Government Printing Office was 510, while the requisitions issued upon the branch office amounted to 1,380.

WEATHER BUREAU PRINTING.

Under your order creating a division of publications in the Weather Bureau, the chief of which is charged with editing the bureau publications, the chief of this division, who is also the editor of the Department publications, is expressly relieved of all responsibility for the editing or supervision of the publications emanating from the Weather Bureau. Nevertheless, first copies of all its publications are mailed at once to this division, and our records therefore contain a full list of Weather Bureau publications, which also find a place in our

monthly list. Though distributed directly from the bureau and by one of its own employees, this employee is, by your order of March 29, 1897, required to report the distribution of documents to the chief of this division, and a record of such distribution is kept in this office, in accordance with the provisions of section 92 of the act of January 12, 1895.

#### THE YEARBOOK FOR 1897.

The general plan and style of the Yearbook for 1897 were outlined in the instructions of the Secretary of Agriculture to the chiefs of bureaus, divisions, and offices, under date of July 14, 1897, from which the following extract is taken:

It is my earnest wish that the Yearbook shall be of such a popular character and of such value to practical agriculture as to justify the enormous edition issued by Congress. Everyone contributing to it should be fully impressed with the fact that every page contained in the Yearbook costs the country \$500, and is designed to be distributed to half a million persons. As the reputation of the Department is assuredly a matter of pride to every one of its officers and scientific workers, I feel confident of the hearty cooperation of each one of you in making this book the best book of its kind ever issued. As soon as the subjects upon which you propose to submit papers are presented to me for consideration, I shall indicate which of them will be acceptable, that the work of preparation may be undertaken as promptly as possible.

The editing of the Yearbook for 1897 will be confided, as in the case of the other publications of the Department, to the chief of the Division of Publications, under the personal direction of the Secretary.

An interesting feature was added to this publication in accordance with your wish, as expressed in the following letter of instructions:

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
*Washington, D. C., September 18, 1897.*

SIR: It is my desire that, in addition to such other suitable articles as may be necessary, the forthcoming Yearbook, 1897, should contain an article from each chief of bureau, division, and office outside of those that are purely administrative, which shall set forth in plain terms the relation of the work of his bureau, division, or office to the farmer. The existence of the Department is justified precisely so far as it aids the farmer to be a successful farmer, and my desire is that the article called for should present clearly to the reader just how the division of the work in your charge achieves that purpose. Let it be such a paper as you would prepare to present to a body of farmers of average intelligence, or before a committee of Congress inquiring into the purpose, character, and practical utility of your work.

\* \* \* \* \*

Very respectfully,

JAMES WILSON, *Secretary.*

The instructions above given resulted in the preparation of a series of 19 papers, aggregating 220 printed pages, which appeared in the first part of the Yearbook immediately after the Report of the Secretary, under the general head of "Work of the Department for the farmer." The Yearbook contained also 18 miscellaneous papers, relating to agriculture and kindred subjects, and the usual appendix, to which were added some new features.

The great demand for information contained in contributions to the Yearbook makes it necessary to reprint separately most of the articles for general distribution. The number of articles in the last Yearbook so reprinted was 37, and the total number of copies reprinted 110,300.

#### DISTRIBUTION OF THE YEARBOOK.

It is unfortunate that the number of copies of this publication available for the use of the Department should be so limited as to



make it impossible for the Department to gratify its own correspondents with a copy. Although 500,000 copies of this book are printed, it can not be too often reiterated that the number of copies at the disposal of the Secretary is but 30,000. From this number, which is not half what the Department needs to supply its own efficient coworkers and correspondents, it is obvious that no miscellaneous distribution can be made. As 470,000 copies, however, are placed in the hands of Senators, Representatives, and Delegates in Congress for distribution to their constituents, this does not perhaps operate as a serious hardship to the public at large; yet it involves an unnecessary amount of clerical labor in answering the thousands of persons who apply for this book directly to the Secretary of Agriculture. The number of these applicants in the past few years has been so great as to make it impossible to write to each a separate letter, and this has led to the adoption of a circular letter, which, however, frequently fails to satisfy the applicants and eventually calls for a full letter of explanation. For this reason it is extremely desirable that the people throughout the country should understand that there is no use in their applying to the Department for this publication. All such applications should be addressed to Senators or Representatives.

The inability of the Secretary to satisfy those who as correspondents, and even as coworkers, cordially cooperate in and aid the work of some one or other of our bureaus, divisions, or offices, is a more serious evil. Ten years ago the number of these correspondents was not one-fifth as large as it is to-day, and the total number of copies of the Annual Reports of the Department printed was less by 100,000 and in some years by 200,000 copies than the present edition of the Yearbook, yet the same number of copies was placed at the disposal of the Department then as now, and was no doubt adequate to meet the requirements of that period; to-day 75,000 copies would not go as far in satisfying legitimate demands as 30,000 did ten years ago, and if the free distribution of the Yearbook is to be continued, it seems obligatory that the first persons to be gratified with a copy of it should be the correspondents and coworkers of the Department. I earnestly recommend, therefore, that Congress be urged to provide for such an increase in the edition of this book as may be necessary to place 75,000 copies at the disposal of the Secretary of Agriculture.

Before dismissing the subject of the Yearbook for 1897 it is proper that acknowledgment should here be made of the cordial cooperation of the Public Printer in the effort made to hasten its appearance, and of the pains taken at the Government Printing Office to make it in every way a creditable work.

#### YEARBOOK FOR 1899.

It is not too early to offer some suggestion as to the character of the Yearbook for 1899. The fact that it coincides in the date of its appearance with the closing year of the century suggests that it be made a medium for presenting to the world a view of American agriculture at the close of the nineteenth century, while some subjects should be treated in the form of a review of the progress and development of the century. The occurrence of the International Exposition at Paris in 1900, and the duty imposed by Congress on the Secretary of Agriculture to prepare an exhibit for that exposition showing the agricultural resources of the United States, suggest that the Yearbook could, in conformity with the above suggestion, be made a most useful



adjunct to such an exhibit, the purpose of which is evidently to extend throughout the world a knowledge of our agricultural resources with special reference to our ability to supply the wants of other nations. Were the Yearbook planned to meet such an object, Congress would doubtless be willing to order an extra 50,000 copies for distribution at the exposition, so as to supply as nearly as possible all the principal libraries, commercial organizations, educational institutions, and leading publicists in Europe.

#### FARMERS' BULLETINS.

The amount expended for printing Farmers' Bulletins during the year was \$32,756.46. The total number of copies printed was 2,170,000, and the cost per copy, therefore, was a fraction over 1½ cents. This is an increase in cost per copy over last year, as the cost last year was an increase over the year previous. This steady though gradual increase is due to the fact that the Congressional demand, which forms the channel of distribution for about four-fifths of these publications, tends strongly to the more expensive ones. The total number of new publications of this series issued during the year was 21, as compared with 16 the year previous, and the number of reprints issued was 75 as compared with 42 the year previous.

Until this year the quota assigned to Senators, Representatives, and Delegates in Congress was 5,000 copies each. In 1897, however, the demands from this source absorbed within 30,000 of the entire number of Farmers' Bulletins prepared and printed from the Farmers' Bulletin appropriation, making it necessary for the Secretary to defray the cost of 390,000 copies out of the general printing fund, already overburdened to supply the regular printing of the Department. It became absolutely necessary, therefore, to reduce the Congressional quota from 5,000 to 4,000 copies. At the same time an effort was made to restrict the cost of preparation and illustration of Farmers' Bulletins so as to allow a larger proportion of the total appropriation of \$35,000 to be expended for printing.

The regular office force, already burdened with work upon the Yearbook and the scientific publications from the several divisions, was called upon to do much of the preparation, proof reading, etc. In this way \$3,000 more than in 1897 was made available from the Farmers' Bulletin fund for the expenses of printing. Under the diminished quota the number of bulletins distributed to Congressmen was reduced from 1,967,237 copies to 1,580,060. In this connection it should also be stated that the demands from Senators and Representatives to be supplied with bulletins in excess of their allotted quotas have been very numerous, and, had it been possible to grant these, the total number of copies distributed by this means would have exceeded 1,700,000. During three months of the year a careful account was kept of the requests thus received for additional bulletins, and they amounted to over 27,000 copies.

#### NEED OF ADDITIONAL FUNDS FOR PREPARATION OF FARMERS' BULLETINS.

The growing demand for Farmers' Bulletins thus indicated has been accompanied by a need for bulletins upon new subjects. Besides the additional labor in editing and proof reading, etc., thus laid upon this division, the scientific divisions have been called upon for more work in supplying manuscripts for these extra bulletins. So considerable has been this increased demand that in several cases it has been

necessary to employ special help, which has been paid for from the Farmers' Bulletin fund.

In view of still greater demands this year for such additional help, not more than \$30,000 of the \$35,000 appropriated for Farmers' Bulletins can be depended upon to pay for printing. As \$31,327.71 was used last year to print a sufficient number of bulletins to give each Member of Congress a quota of 4,000, it is obvious that unless this allotment is to be further reduced more than \$35,000 must be given for printing, editing, etc., during the coming fiscal year.

FARMERS' BULLETINS ISSUED, PRINTED, AND DISTRIBUTED.

In Appendix B of my report are given a list of the Farmers' Bulletins issued, the number of each printed, and the total number distributed through Senators, Representatives, and Delegates in Congress, and to miscellaneous applicants. The total number printed during the year was 2,170,000; distributed through Congressional orders, 1,580,065, and to miscellaneous applicants, 694,285. It will be observed that Members have received 133,398 bulletins in excess of the two-thirds of the total distribution allowed them by law, although of many individual bulletins considerably less than two-thirds are shown to have been so distributed. This is due to the fact that within certain broad limits, Senators, Representatives, and Delegates have been allowed to select such bulletins as they preferred, and in many cases make up their entire quota from a very few bulletins.

The following statement shows the cost of all Farmers' Bulletins printed during the year:

*Statement of cost of Farmers' Bulletins.*

Item.	Copies.	Cost.
Printed and paid from Farmers' Bulletin fund .....	2,095,000	\$31,327.71
Printed and paid from general printing fund .....	45,000	850.34
Printed and paid from Animal Industry fund .....	30,000	578.41
Total .....	2,170,000	32,756.46

In addition to the above, the following is a résumé of the number of Farmers' Bulletins, originals, reprints, and totals, and of the Congressional distribution since the first Farmers' Bulletin was published. A considerable number of these were so distributed before 1895, the first year when a special appropriation was provided and a Congressional distribution ordered, but no separate figures were then kept of bulletins so distributed, and the figures in this table give the distribution through Members of Congress only since and including 1895.

*Congressional distribution of Farmers' Bulletins, Nos. 1 to 78.*

Date.	Total number issued.	Distributed to Congressmen.
Prior to 1894 .....	540,000	-----
In 1894 .....	278,500	-----
In 1895 .....	1,567,000	885,770
In 1896 .....	1,891,000	1,316,695
In 1897 .....	2,387,000	1,967,237
In 1898 .....	2,170,000	1,580,065
Total .....	8,833,500	5,749,767

## COST OF PRINTING AND BINDING.

As stated in my last report, it is, of course, impossible to give the precise cost of printing and binding all the Department publications. As already shown, 113 of these publications were printed at the Weather Bureau printing office and 12 were printed as executive documents. While the total cost of the printing at the Weather Bureau printing office can be arrived at, a great deal of printing is done there besides the publications referred to, and there is no means of arriving at the cost properly chargeable to them. As regards the executive documents, the cost of printing them is defrayed by the Public Printer out of funds with which this division has no concern. There is no reason to revise the approximate estimate made in my last report, that the executive documents, which include the Year-book, the reports of the chiefs of the Weather Bureau and Bureau of Animal Industry, and other special and unusually important publications, will aggregate over \$400,000, to say nothing of the cost of distribution and transportation through the mail. The following table gives in detail the total number of publications (original and reprint) issued from each division, with the total number of copies and the cost of the printing for each division:

*Number and cost of publications, by divisions.*

Division, etc.	Publications.			Total number copies.	Cost.
	Original.	Re-prints.	Total number publications.		
Secretary's Office.....	3	13	16	138,500	\$2,439.74
Executive documents.....	9	2	11	1,021,944	-----
Accounts.....	-----	2	2	500	971.57
Agrostology.....	10	11	21	180,250	1,205.72
Biological Survey.....	2	9	11	69,100	1,292.28
Botany.....	9	11	20	71,250	1,310.05
Animal Industry.....	11	25	36	644,000	4,396.25
Chemistry.....	3	14	17	96,850	2,327.79
Entomology.....	19	16	35	217,950	2,973.90
Experiment Stations.....	39	50	89	814,000	18,232.77
Fiber Investigations.....	1	5	6	22,500	972.21
Foreign Markets.....	6	8	14	159,250	2,904.11
Forestry.....	8	7	15	57,000	2,742.13
Gardens and Grounds.....	1	2	3	5,300	27.87
Library.....	7	1	8	7,700	2,848.92
Pomology.....	4	4	8	23,600	1,583.14
Publications.....	16	3	19	317,000	2,976.83
Road Inquiry.....	3	2	5	27,500	435.38
Soils.....	6	6	12	59,750	1,731.36
Statistics.....	11	3	14	1,545,500	6,608.67
Vegetable Physiology and Pathology.....	4	14	18	248,250	1,517.49
Weather Bureau.....	119	2	121	557,671	9,425.17
Total.....	291	210	501	6,280,365	68,423.35

The following statement shows the expenditures from the several funds, the total being \$117,876.10:

*Cost of printing, by funds.*

General printing fund:		
Expended for various divisions.....	\$65,731.74	
Expended for branch printing office.....	18,125.04	
		\$83,856.78
Farmers' Bulletin fund.....		31,327.71
Divisional funds:		
Bureau of Animal Industry.....	\$2,375.63	
Division of Botany.....	315.98	
		2,691.61
Total expended for printing.....		117,876.10



## BRANCH PRINTING OFFICE.

Of the total number of requisitions drawn upon the Public Printer during the year, 1,380 were drawn upon the branch office, an increase of over 25 on the previous year and of 143 over the year 1896. The table following shows the total number of envelopes, letter heads, cards, circulars, blanks, etc., covered by the 1,380 requisitions drawn on the branch office from June 10, 1897, to June 30, 1898, with a statement covering the number of requisitions drawn yearly since the branch office was placed under the supervision of the writer, together with the yearly cost of the work:

*Work done in branch printing office.*

	Number.
Envelopes .....	628,000
Letter heads .....	486,500
Cards .....	784,000
Circulars .....	2,936,500
Blanks .....	2,015,000
Labels and shipping tags .....	594,500
Franks .....	4,644,500
Monthly and other lists .....	330,500
Miscellaneous .....	37,000
Total .....	12,456,500

*Number of requisitions and cost of work, 1896-1898.*

Year.	Number.	Cost.
1896 .....	1,237	\$16,049.34
1897 .....	1,335	17,075.18
1898 .....	1,380	18,125.04

The circulars printed in the branch office comprise 533 printed pages, showing a considerable increase in this class of work during the past year.

It is proper that I should state here that the work of the branch office has never been so satisfactorily performed as since it has been in charge of the present foreman, Mr. Frank Wallace.

If ever a new building is erected for the use of the Division of Publications, provision should be made for the branch printing office, now quartered in the basement, where the rooms are damp and unhealthful.

## ILLUSTRATIONS.

During the past fiscal year the work of illustrations has been considerably reduced. Five hundred and seventy-seven drawings and illustrations, mostly in pen and ink, but including several in colors, were made under the immediate supervision of the chief of this division, and of these 361 were reproduced for publication at a cost of \$914. In addition to these the artists permanently attached to the Bureau of Animal Industry, to the Divisions of Entomology, Botany, Agrostology, and Pomology have performed a large amount of work under the supervision of their respective chiefs. None of this work comes under the notice of the chief of this division, save as it may be submitted with manuscript for publication. Many of the drawings thus made are for office use and not for general publication.

The amount expended for artists' supplies, which are furnished by



this division for the use of all the artists of the Department, was \$134.83.

The total number of requisitions for artists' material was 134. The total number of illustrations published, including those reproduced through the Government Printing Office, was 1,838. These include a large number prepared during the year previous.

Thanks to the efforts put forth to complete the classification and numbering of all the original cuts and electrotypes owned by the Department, the labor involved in supplying duplicate electrotypes for the use of various journals and publications, of the experiment stations, etc., has been very much reduced. The original of any cut or electrotype called for, by reference to the page and title of the publication in which it appeared, can be produced in a few minutes' time. The number of illustrations thus reproduced for the use of outside publications during the year was 1,188. That number represents 139 separate requests. I append a statement showing the illustration work, by divisions, during the fiscal year, by which it will be seen that out of a total of \$4,137.57 there was paid from certain divisional funds \$3,223.57.

It is strongly recommended that the work of reproduction of illustrations be continued without making any contract with any particular firm. The illustration work of the Department is so varied, including wood engraving, photo-engraving, half tone, and photolithography, as to make it a matter of great convenience, and conducive to far more satisfactory results, if each piece of work is awarded independently. Moreover, this plan permits of a trial being made at any time of any of the new methods which are being constantly adopted.

*Expenditures, by divisions, for illustrations for the fiscal year ended June 30, 1898.*

Division, etc.	Number of illustrations.	Cost of illustrations.	Amount chargeable to divisional funds.	Amount chargeable to illustration fund.
Agrostology .....	74	\$465.52	\$320.60	\$144.92
Animal Industry .....	21	2,145.70	2,100.55	45.15
Biological Survey .....	43	100.55	65.25	35.30
Botany .....	59	82.34	-----	82.34
Entomology .....	77	870.46	727.78	142.68
Experiment Stations .....	17	68.40	7.89	60.51
Forestry .....	11	264.36	-----	264.36
Pomology .....	1	3.90	-----	3.90
Publications .....	28	50.85	-----	50.85
Road Inquiry .....	2	23.03	-----	23.03
Secretary's Office .....	7	19.28	-----	19.28
Vegetable Physiology and Pathology .....	19	36.99	1.50	35.49
Weather Bureau .....	2	6.19	-----	6.19
Total .....	361	4,137.57	3,223.57	914.00

#### NEED OF OFFICIAL PHOTOGRAPHER.

The need of an official photographer for this Department has been suggested the past year by several of the chiefs of divisions, and although there are in several of the divisions gentlemen capable of doing excellent work in photography, it is obviously impossible to depend upon them at all times for a great deal of work, which should be undertaken if the work of illustrating our publications suitably is not to be abandoned. The work of development of negatives taken in the field and the preparation of slides for use in illustrated lectures

could be advantageously intrusted in most cases to an official photographer, and in many ways work would be carried on with more system instead of being necessarily dependent upon the convenience of persons engaged regularly in other work and only devoting themselves incidentally to photography. The same person could take charge of photographic supplies, and should the suggestion of a building to accommodate the document section and the branch printing office be adopted, suitable accommodations for photographic work should be provided therein.

#### INCREASED CORRESPONDENCE.

In the act making appropriations for this Department for the current year there is a clause for the printing of 75,000 copies of the "Special report on diseases of the horse," and 60,000 copies of the "Report on diseases of cattle, and cattle feeding," the entire edition of both publications being for the use of Senators, Representatives, and Delegates in Congress. As soon as it became known that new editions of these reports had been authorized by Congress many applications were addressed to the Department, every one of which received a reply, explaining that, although the provision for printing the reports occurs in the appropriation for the Department, the distribution is entirely through Congressmen. These requests continue to be received, and involve considerable correspondence.

#### DIVISIONAL PUBLICATIONS.

During the year some important publications were issued from this division, among them being the Synoptical Index to the reports of the Statistician of this Department, referred to in my last report as then in the hands of the printer. The author, Mr. George F. Thompson, formerly in charge of the document section, has during the past year undertaken an authors' index to the Department publications. The bulk of the work was done by Mr. Thompson while still employed in this division, yet the whole of it from first to last was practically done by him outside of office hours, and he continued and completed the work under the same conditions after his transfer to the Bureau of Animal Industry.

Another valuable contribution to publications of the division during the year was an "Historical sketch of the Department of Agriculture," compiled by Mr. C. H. Greathouse, of this division. It is a book which will serve to answer a great many inquiries. It contains portraits of all the Commissioners and of the first three Secretaries, while the leading features of each administration are compiled from the several annual reports. Mr. R. B. Handy, now assistant in charge of the document section, prepared a Farmers' Bulletin on "Asparagus culture," and also contributed to the Division of Botany the material collected and prepared by him for a bulletin on "Celery culture."

The Division was also represented by an article prepared by the chief in the Yearbook for 1897, one of the series entitled, "Work of the Department for the farmer," in which the present status of the publication work of the Department was presented and the methods of distribution explained. With a view to adding to the interest of the article in question, a general review of the development of the publication work in agriculture, from the earliest available records, was included.

## DOCUMENT SECTION.

On the 1st day of March, 1898, Mr. George F. Thompson, assistant in charge of the document section, was, at his own request and upon the invitation of the chief of the Bureau of Animal Industry, transferred to the position of editor in that bureau. He was succeeded by Mr. R. B. Handy, who had for more than four years been in the employ of the Department both in the Office of Experiment Stations and in the Division of Publications. For detailed information in regard to the work of the document section for the year, I respectfully refer to Mr. Handy's report, which follows:

U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF PUBLICATIONS,  
*Washington, D. C., August 27, 1898.*

SIR: Although my connection with the document section began as late as March 4, 1898, this report is intended to cover the entire fiscal year ended June 30, 1898.

Since the last report was made the work of perfecting the system under which the distribution of the publications of this Department was conducted has been kept continually in view in the administration of this section, and while the volume of the work done has steadily increased, the force has been employed in such a systematic way that the additional demands have been fully met, and at times work not strictly pertaining to this office has been undertaken for other divisions.

## BOOKKEEPING.

The system of bookkeeping adopted last year has proved very satisfactory and is therefore continued. There has been, however, an effort to perfect the system, that the detailed distribution might be recorded more fully than was believed possible when the system was originated. A single bookkeeper keeps account of all publications received and distributed, with the exception of the Farmers' Bulletins, the books, designed and prepared specially for this work, being so simple and yet so perspicuous that the work is greatly facilitated.

A separate set of books is kept for the series of Farmers' Bulletins, showing the receipt and distribution in detail and an account of when drawn by Senators, Representatives, and Delegates for distribution in their States and districts. These are in charge of another clerk.

The foreman mails no publication except upon an order properly signed and stamped with the consecutive numbering machines kept in the office of the document section. These orders, after being filled, are filed for reference, so that at any time a statement can be made when a given publication was forwarded to any address. They serve as the daybook or blotter for the bookkeepers, and a separate series of orders is kept for Farmers' Bulletins and miscellaneous documents.

## CARD INDEXES.

The keeping of card indexes of the addresses to which the Yearbooks and other specially valuable documents are sent has been tested so often and proved so valuable that the system has been extended as far as practicable; and it is my opinion that a card index should be kept of every one of the more valuable publications of the Department, as otherwise duplications must be frequent even in the hands of the most careful clerks, and with limited editions this occasions serious loss. No other system furnishes so sure a means of detecting duplicate orders from different divisions.

In addition to the card index, each volume of the Yearbook for 1897 mailed to persons in the United States, Canada, and Mexico has been registered, thus insuring its delivery to the addressee or return to this Department. This certainty, I am sorry to say, is not true of our other publications, which, though complaint is frequently made of their nonreceipt, seldom find their way back to the Department. In this connection it is proper to express my appreciation of the kindness shown and able assistance afforded us in this matter by the local postal officials.

It would doubtless be a great assistance to the work of this section if registration were made of all publications which are sufficiently valuable to warrant the keeping of a card index, and also if a duplicate of the mailing list of each division of the Department were kept in this section.



## CORRESPONDENCE.

Your instructions given to my predecessor in regard to a prompt reply being sent to every communication received have been faithfully carried out, and the more important letters are filed and carefully preserved.

So far as possible, printed forms of letters and postals are used in this correspondence, but a large number of the requests require the preparation of special letters. The magnitude of this work will be seen when attention is called to the fact that my predecessor prepared 1,051 such letters during the month of February, current year, for the signature of the Secretary or yourself. A calculation based upon a careful count of letters receiving attention in one way or another during two weeks of rather a leisure season (Congress not being in session) indicates the number received to be over 90,000 per annum.

A proper disposal of this correspondence requires considerable familiarity with the subjects treated in the numerous publications of the Department, and as many of the applications are for publications issued by some other Department, the work involves acquaintance with the contents of Government publications generally, so that reference may be made to the proper Department. In this work the monthly catalogue and general indexes prepared by the Superintendent of Documents are of great assistance.

In reply to the thousands of requests for the hundreds of different publications of this Department, great assistance has been afforded by the indexes of publications so far issued, especially Bulletins Nos. 1, 2, and 4 of the Division of Publications, entitled, "Index to Annual Reports, 1837-1893," "Index to reports of the Statistician, 1863-1894," and "Index to authors, 1841-1897." These have enabled the document section to give specific replies to requests for information, and in many cases furnish the publication desired when but a vague idea of the document wanted was in the mind of the person requesting it. The best work in this line will be done when indexes of all the Department publications are issued.

## DISTRIBUTION OF FARMERS' BULLETINS.

The work of putting up Farmers' Bulletins for Congressmen in envelopes ready for addresses and marked with the name of each bulletin necessitates a great amount of work, but the results are so satisfactory that the extra work entailed would be fully justified, even if the law did not require it. In many cases addressed franks are furnished to the Department by Senators, Representatives, and Delegates, and the pasting of these franks increases the work, but at the same time has its compensation in the fact that the post-office officials are not required to handle the mail as frequently as would be the case if the bulletins were first mailed in bulk to the Congressman and then redistributed by him. An idea of the work done in this line may be had from the following figures: Over 1,580,000 Farmers' Bulletins were distributed by 405 Senators, Representatives, and Delegates in Congress during the last fiscal year, and over 694,300 were mailed to miscellaneous applicants, making a total of over 2,274,300 Farmers' Bulletins distributed from this office. (For detailed statement, see Appendix B of your report.)

## OTHER PUBLICATIONS DISTRIBUTED.

Besides the Farmers' Bulletins, there are many publications of the Department, varying from Congressional documents, such as the Yearbook, the Annual Report, the Report of the Bureau of Animal Industry, etc., down to one-page press notices, each and all of which are wrapped, or inclosed in an envelope, and mailed by the force under my direction. As shown in the tabulated statement (see Appendix B), the editions of these publications are not at all uniform, varying from nearly 200,000 of the Monthly Crop Circular to 1,000 where the editions (because the publications contain more than 100 pages) are limited by law to that number, and even a smaller number in the case of reprints. The total number of miscellaneous publications received was 2,263,861, and the distribution to miscellaneous applicants aggregated 3,113,797.

To wrap and address the more than 3,000,000 copies of these publications is quite a laborious task, and the promptness with which this work is done speaks well for the system originated under your direction by my predecessor and carried out by me. Under the present method, by which, as required by law, a careful record is kept of the distribution of each publication, every applicant's name and address must be written at least twice, making over 6,000,000 addresses in all.

But this is not all. The force in this section sent out the monthly township circulars, 117,000, and county correspondent circulars, 10,000, for the Division of Statistics, besides considerably over 20,000 Monthly Lists of Publications, making



a total of not less than 1,750,000 circulars per annum, besides the miscellaneous publications and Farmers' Bulletins accounted for above, making a grand total of over 7,000,000 documents.

#### WRITING LISTS.

This section prepares by far the greater number of the 3,000,000 addressed envelopes sent out by the Division of Statistics. In fact, the larger part of that kind of work done in the Department falls upon the force employed in this section, as many of the lists belonging to the different divisions are either kept in this office or sent to it when it is desired that a set of envelopes or franks be prepared for mailing.

#### WORK FOR OTHER DIVISIONS.

It has been your policy, as chief of the Division of Publications, to render what assistance is possible to other divisions in work which, while not exactly falling within the province of this section, was nevertheless within its capacities; therefore the force has frequently been called upon to render much and various degrees of assistance, and has also been drawn upon to supply laborers, messengers, typewriters, and clerks, for longer or shorter periods, during absences on leave or on account of sickness of the persons regularly employed for the work.

#### INADEQUATE ACCOMMODATIONS.

With the exception of minor changes, the section is still occupying the same space that was mentioned in the last report, and I feel compelled to repeat the recommendation that this matter should have serious attention. It is true that the removal of documents from what was known as the "lunch room" to the second floor of the "forestry building," thus giving three rooms in that building and only two on the east end of the museum building, and the erection of additional bins in the rooms allotted to Farmers' Bulletins and miscellaneous publications, and of new shelves in the forestry rooms, have afforded better facilities for the arranging and keeping of the publications; but the employees have the identical quarters to which my predecessor called attention.

I would neglect what I feel to be a duty did I fail to call attention to the condition of the structure in which so much valuable material is stored, and in which so many persons are employed each day.

One serious feature of the inadequate accommodations is to be found in the inability to provide commodious storage for the publications, the present crowding occasioning considerable extra labor in the way of rehandling, or handling under difficulties, thousands of publications during the year. Besides this, the inflammable nature of the material of which the building is made, and of that which is stored in such large quantity therein, makes the fire risk very great; and the sanitary condition, especially for those upon the ground floor, is far from desirable.

Respectfully,

R. B. HANDY,

*Assistant in Charge of Document Section.*

Mr. GEO. WM. HILL,  
*Chief, Division of Publications.*

#### NEED OF BETTER ACCOMMODATIONS.

There are some points in the foregoing report to which I desire to call special attention. I find it necessary to repeat with added emphasis all that was said in my last report in regard to the urgent need of better accommodations. Prudence, hygiene, and economy all combine to make some improvement in this respect a necessity, nor do I see any means by which the necessary and suitable accommodations can be provided without undertaking some new building. Such a building should be made available for the accommodation of the branch printing office, and for such artists as remain under the supervision of the chief of this division, and for the storage of the electrotypes, which now take up a large amount of room on the top floor of the main building. A speaking tube leading from the editorial rooms of the division to the document section and branch printing office,

and a pneumatic tube connecting them with the former, for the transmission of publications and proofs between this new building and the main office, would result in a great economy of time and labor.

#### LARGE AMOUNT OF CLERICAL WORK.

Your attention is respectfully invited to the very large amount of clerical work involved in conducting the business of the document section, and necessarily, by the enormous correspondence, the keeping of index lists, the addressing of documents and circulars, and lastly, but by no means least, the large amount of bookkeeping necessitated by our effort to comply with the law in preventing duplicates, accounting in detail for the distribution of each document, and keeping the Farmers' Bulletin accounts of more than 400 Senators, Representatives, and Delegates. I cordially concur in my assistant's recommendations in all respects, and in this connection desire to express my high appreciation of the energy and capacity Mr. Handy has shown since your appointment of him as assistant in charge.

#### METHODS OF DISTRIBUTION.

There has been no change in the method of distribution of our publications during the past year. The system approved by you at the beginning of your administration has been carried out as fully as possible with the single object of making the largest number possible of our publications available to the largest number of people. Occasionally some difficulty has been met with in carrying out the system of mailing, which seems to be distinctly imposed upon the Department by law (act regulating public printing and binding of January 12, 1895, section 92). Under this law the person detailed by you to superintend the distribution of our publications is required to keep an account in detail of all publications received and distributed by him. This account will be found in Appendix B. It is also provided that he shall prevent duplication and make detailed report to the head of the Department, who shall transmit the same annually to Congress. It is elsewhere provided in the law, with regard to the distribution by the Superintendent of Documents, that only one copy of any one publication shall be supplied to each applicant. Under those circumstances it has been thought proper to decline to honor the numerous requests received from various persons for a quantity of some one publication which they desire to distribute themselves. Such requests are not infrequently indorsed by officers of the Department, which adds much to the embarrassment of a refusal. It would be well that the rule of the Department in this respect should be more fully recognized by all persons connected with it. Aside from the requirements of the law cited it has been impressed upon the chief of this division that it was the clearly defined intention of the Secretary that all the work of mailing our publications and circulars of various kinds should be carried on in the folding room, where a large class of labor specially adapted to such work is necessarily employed, thus relieving the force of the various divisions as far as possible from this work. The apparent want of a clear understanding on this subject necessitated the issuing on January 28, 1898, of a general order calling attention to the provisions of the law and the rules governing the distribution of the Department publications and directing a rigid compliance therewith.

Since this order was issued evasions of the rule have been confined to rare instances, and doubtless no further difficulty will be met with in carrying out the policy therein laid down. It seems not to be appreciated by some persons that the general work of a large division being carefully planned to conform to a certain policy, repeated deviations from established methods are vexatious, and should never be permitted save in exceptional cases and for urgent reasons.

#### GENERAL SUMMARY.

Before proceeding to further considerations, I desire to briefly summarize here for your information the main features of the work accomplished in the Division of Publications during the year:

(1) Three hundred and eighty publications edited and supervised and prepared for the printer, the new publications alone covering 10,628 pages.

(2) The Yearbook edited and indexed; a book aggregating 800 pages octavo and containing 85 illustrations (40 plates and 45 figures).

(3) Five hundred and seventy-seven original drawings made by artists under the supervision of the division; 1,838 illustrations reproduced from original drawings for publication; 1,188 illustrations duplicated for use in outside publications.

(4) Over 7,000,000 publications and documents of various kinds handled, wrapped, or inclosed and mailed.

(5) Three million five hundred thousand franks and envelopes addressed, each one of which involved one, and in many cases, two additional records, comprising date, name, and address.

(6) The publication of Synoptical Index to the Reports of the Statistician, a Farmers' Bulletin on Asparagus Culture, and a bulletin giving an historical sketch of the origin and development of the Department.

(7) The disposal of a correspondence aggregating over 95,000 letters.

(8) The administration and keeping of accounts of expenditures aggregating \$150,000, and the keeping of ledger accounts of all publications issued by the Department and with 405 Members of Congress for Farmers' Bulletins.

(9) Supervision of all work done in the branch printing office, involving 1,380 jobs of work.

It would not be becoming in me to present this summary of work done without a tribute to the intelligence, industry, and willingness shown by the members of the divisional force. With very few exceptions there is not a member of the force who does not willingly sacrifice his or her personal convenience for the general good, cheerfully contributing extra time, while for some years past it has been a rare thing that a member of our divisional force has enjoyed a full term of leave as allowed by law. I take this opportunity to express my appreciation of the part of my assistants in performing the vast amount of work devolving upon this division.

#### SALE OF DOCUMENTS.

I am indebted to the courtesy of the Superintendent of Documents for a statement of the sales of Government publications for the fiscal year 1898. These sales include regular subscriptions to certain publications, such, for instance, as the Experiment Station Record, which are issued periodically. The total amount of sales of publications of



this Department by the Superintendent of Documents for the fiscal year 1898 was 17,740 copies, and the amount realized therefor was \$2,089.15, the total number sold last year, as finally reported, being 14,674, and the amount received therefor \$1,891.85. The Superintendent of Documents says: "I think I am safe in saying the sales for your Department would have been one-third to one-half larger if we could have supplied all the demands made upon us."

The statement kindly furnished us includes the sales for all the Departments, and it is interesting to know that the total number of copies of publications disposed of for all Departments was 21,363, being 3,623 for all other Departments as by comparison with 17,740 for the Department of Agriculture. The total amount of money received for publications of all the Departments was \$4,537.27, being \$2,448.12 for all other Departments as against \$2,089.15 for the publications of this Department. The average cost of the publications of this Department, according to this statement, was a fraction under 12 cents per copy, while the average cost of the publications per copy of the other Departments slightly exceeded 67 cents.

The extent to which this sale of Government publications, especially of this Department, has been carried, affords, I venture to suggest, strong justification for the adoption of a system by which all the publications of the Department should be placed on sale at cost, less the cost of composition, and with a slight addition, say 10 per cent, for handling, free distribution being reserved to such exchanges, free libraries, and active correspondents as are deemed by the Secretary to be entitled to such privilege, and to such publications as might be termed emergency publications, designed to propagate as widely and speedily as possible certain important information vitally affecting agricultural conditions, or to such brief circulars as might be utilized in the work of the division as a substitute for correspondence. Free distribution of all documents should, of course, be extended to the agricultural colleges and experiment stations and to the principal agricultural officials of the several States. The adoption of a system by which the general publications of the Department shall be sold in all cases rather than given away, will effectually put a stop to all waste, and by providing a fund from which reprints can be paid for as long as the demand for any publication continues, will solve what now presents itself as a very serious question, namely, the possibility of meeting a demand for the publications of the Department which has increased more than 100 per cent in the past five years and which seems likely to continue to increase at the same rate, or even faster, during the next five years; for it must be borne in mind that all the greatly increased and increasing educational facilities and agencies throughout the country are adding constantly to the number of applicants for publications of this Department.

#### RECOMMENDATIONS.

The editorial work of the division is such as to call for more than one editorial clerk. In fact, in addition to such work of this character as can be done by the chief and his assistant, and which is necessarily, frequently interrupted by the performance of administrative duties, there are at least three persons now employed exclusively in editorial work, while the time of one person at least is wholly employed in connection with Farmers' Bulletins.

I recommend, therefore, that provision be made for another editorial



clerk at \$1,600, and I have, in addition, to repeat the recommendation already made on two previous occasions, that the salary of the assistant chief of this division be fixed at \$2,000.

The extraordinary pressure brought to bear upon the Department and the numerous appeals to the Secretary on the part of Senators and Representatives for publications additional to their quotas of Farmers' Bulletins, as well as the large number of Congressmen availing themselves of this distribution, call for an increase in the amount of the appropriation for the printing and preparation of these useful publications. We have reached the full limit which can be supplied from the funds appropriated for the purpose, and there is every evidence that we are far from having reached the full limit of the demand, both from Congressmen and from miscellaneous applicants. The correspondents of the Department particularly are urging with great justice that they should be more liberally recognized in this distribution. By relieving the fund of the salary of one of our editorial assistants now carried on this roll and adding at least \$5,000 to the appropriation we can increase the number printed by about 400,000.

The sum at present allotted for the work of distribution, also the cost of envelopes, etc., of artists' materials, and the employment of additional labor, including additional proof readers and indexers when necessary, is highly inadequate. A considerable force is constantly engaged in the document section, made up of persons detailed from other divisions, a method most unsatisfactory both to ourselves and to the other divisions concerned. The increase in this year's printing fund and the increase asked for in the Farmers' Bulletin fund will necessarily add to the cost of distribution. Every additional thousand documents printed and circulars mailed adds so much to this branch of the work. There has been a very large increase, as the figures already presented show, in the number of publications, but during the last three years our efforts have been constantly directed to discriminating in the distribution so as not only to prevent duplication but to restrict the number distributed as far as possible. In spite of these efforts, however, there has been no considerable reduction in the number of publications sent out, while all the indications at present point to a great increase in this direction. It must also be borne in mind that in addition to the simple distribution of publications asked for, great as is that labor, a very great deal of work is involved in the sending out of circulars of information and inquiry for the various divisions. This involves in many cases not only the mailing but the addressing of such circulars, the total number of which exceeded 1,750,000 last year.

It is also extremely desirable that the Secretary should have a fund available from which he can, if necessary, pay for special articles and bulletins or monographs contributed by specialists and experts outside the Department. The occasions when such expenditures are called for are not common, but they do occasionally occur, and it is a very difficult matter to find a fund from which they can be legitimately defrayed. The general appropriation of this division ought to be so worded as to make it available for such expenses.

#### NECESSITY FOR GENERAL INDEX.

Under the general appropriation, as at present worded, the very important work of indexing all the publications of the Department could be now undertaken; but the small amount appropriated, already

utterly inadequate to cover the necessary expenses of distributing our publications, to say nothing of the work of illustration, precludes any possibility of undertaking this indexing until a more liberal appropriation is allotted to us. Whatever we have been able to do so far in the way of indexing we have had to undertake and accomplish piecemeal, such as the "Index to the Annual Reports" and the "Synoptical index to the Statistician's reports," and only by the imposition of a large amount of extra work upon individual members of the force has it been possible to do even this much. Were it not that this matter has been neglected for all these years for want of means to perform it, it would be difficult to suppose that any argument could be needed to prove the necessity of maintaining a comprehensive index to all the publications of the Department, which now amount of themselves to a considerable library. Without a good index a very large amount of their valuable contents is necessarily unavailable to those who would make the best use of them, while the saving of time such an index would secure to the employees of the Department alone, to say nothing of scientific investigators outside, would pay the cost of maintaining it many times over.

With the estimates for this division increased as proposed, it would be possible to at last undertake this work and effect at least a good beginning, when it would doubtless be carried on and completed with such assistance as would be forthcoming from the Office of Experiment Stations and the Library.

#### AMENDMENTS TO THE PRINTING BILL.

In my last report I pointed out a number of features in the act providing for the public printing and binding approved January 12, 1895, which experience has shown to seriously interfere with the publication work of this Department. In the report of the Secretary for 1897 these objectionable features were discussed at length and suggestions offered for their removal. In accordance with your recommendations, amendments to the bill were placed in the hands of the Printing Committee of the Senate to receive due consideration, together with other amendments which had been offered. No action, however, was taken with reference to any amendment to this act during the last session of Congress.

Your own views having been thus clearly expressed on this subject, I simply present these features here as a matter of record and without argument.

The first hurtful restriction it was sought to remove was that provision under section 89 of the act referred to, by which the Secretary of Agriculture is compelled to restrict to an edition of 1,000 copies any reports and bulletins issued by him which exceed in size 100 octavo pages.

It was also desired to remove the limitations imposed on the Public Printer by section 42 of the act in question which prevents him furnishing any applicant, giving notice before the matter is put to press, more than 250 copies of any publication.

The number of copies of the Yearbook assigned to the Secretary for his use is now fixed under this law at 30,000. Your recommendation was that the Department's quota be increased to 50,000. The necessity for this increase exists even more strongly to-day, as has already been shown in this report.

Lastly, the recommendation was made that moneys received by the

Superintendent of Documents in payment for publications of this Department should be subject to the order of that officer, with the approval of the Secretary, for reprinting publications the editions of which were exhausted, should the continued demand seem to justify it. It gives me pleasure to add to this statement the following extract from a recent letter of the present Superintendent of Documents, Mr. L. C. Ferrell, which reads as follows:

I agree with the Secretary's statement in his last report, that the Department ought to be credited with the amount received by the sale of its publications. At any rate, I trust you can supply us with enough documents to enable us to supply those who are anxious to secure them by purchase.

## APPENDIX A.

## PUBLICATIONS ISSUED DURING THE YEAR ENDED JUNE 30, 1898.

[The following publications were issued during the year ended June 30, 1898. Those to which a price is attached, with the exception of publications of the Weather Bureau, must be obtained of the Superintendent of Documents, Union Building, Washington, D. C., to whom are turned over all copies not needed for official use, in compliance with section 67 of the act providing for the public printing and binding and the distribution of public documents. Remittances should be made to him by postal money order. Weather Bureau publications to which a price is attached must be obtained from the chief of that bureau. Applications for those that are for free distribution should be made to the Secretary of Agriculture, Washington, D. C.]

## OFFICE OF THE SECRETARY.

	Copies.
Irrigation on the Great Plains. By Frederick H. Newell, Chief Hydrographer, U. S. Geological Survey. Pp. i-ii, 167-196, Pls. III-IV, figs. 31-39, from Yearbook for 1896. July, 1897.....	500
Reprint, January, 1898.....	1,000
An Ideal Department of Agriculture and Industries. By E. Tisserand, Councillor of State and Director of Agriculture of France. Pp. i-ii, 543-554, from Yearbook for 1896. July, 1897.....	500
Farm Drainage. By C. G. Elliott, C. E., Member of the American Society of Civil Engineers, Peoria, Ill. Pp. 24, figs. 6. Farmers' Bulletin No. 40. (Reprint.) August, 1897.....	10,000
Sheep Feeding. By John A. Craig, Professor of Animal Husbandry in the University of Wisconsin. Pp. 24. Farmers' Bulletin No. 49. (Reprint.) August, 1897.....	30,000
Reprint, February, 1898.....	20,000
Washed Soils: How to Prevent and Reclaim Them. Pp. 23, figs. 6. Farmers' Bulletin No. 20. Published by authority of the Secretary of Agriculture. (Reprint.) August, 1897.....	10,000
Marketing Farm Produce. By George G. Hill, formerly Manager and Editor of the American Farmer, Illinois. Pp. 28, figs. 7. Farmers' Bulletin No. 62. October, 1897.....	20,000
Reprint, January, 1898.....	20,000
Austria-Hungary as a Factor in the World's Grain Trade; Recent Use of American Wheat in that Country. By Frank H. Hitchcock, Chief, Section of Foreign Markets. Pp. 23. Circular No. 19. November, 1897.....	10,000
Report of the Secretary of Agriculture. 1897. (Preliminary.) November, 1897.....	30,000
Number, Status, and Compensation of Employees in the Department of Agriculture. By J. B. Bennett, Appointment Clerk. Pp. 4. Circular No. 6. January, 1898.....	1,000
Reprint, January, 1898.....	1,000
Reprint, April, 1898.....	1,000
Sewage Disposal on the Farm, and the Protection of Drinking Water. By Theobald Smith, M. D., Professor in Harvard University, Pathologist to the Massachusetts State Board of Health, etc. Pp. 20, figs. 8. Farmers' Bulletin No. 43. (Reprint.) February, 1898.....	10,000
Beet-Sugar Industry in the United States. Report of Special Agent Charles F. Saylor. Pp. i-iv, 161-233, from House Doc. No. 396, 55th Cong., 2d sess. June, 1898.....	500



## SECTION OF FOREIGN MARKETS.

	Copies.
United States Wheat for Eastern, Asia. By Frank H. Hitchcock, Chief of Section of Foreign Markets. Pp. 8. Circular No. 17. July, 1897 .....	10,000
Hawaiian Commerce from 1887 to 1897. By Frank H. Hitchcock, Chief of Section of Foreign Markets. Pp. 37. Circular No. 18. July, 1897..	10,000
Report of the Chief of the Section of Foreign Markets for 1897. By Frank H. Hitchcock. Pp. i-iii, 177-180, from report of the Secretary of Agriculture for 1897. December, 1897.....	250
Agricultural Imports and Exports, 1893-1897. By Frank H. Hitchcock, Chief of Section of Foreign Markets. Pp. 15. Circular No. 20. (Reprint.) February, 1898.....	65,000
Our Foreign Trade in Agricultural Products during the five fiscal years 1893-1897. Prepared by Frank H. Hitchcock, Chief of Section of Foreign Markets. Pp. 38. Bulletin No. 10. March, 1898. Price, 5 cents..	20,000
Spain's Foreign Trade. Prepared by Frank H. Hitchcock, Chief of Section of Foreign Markets. Pp. 47. Bulletin No. 11. April, 1898. Price, 5 cents .....	8,000
Reprint, May, 1898 .....	500
Our Trade with Spain, 1888-1897. Prepared by Frank H. Hitchcock, Chief of Section of Foreign Markets. Pp. 47. Bulletin No. 12. April, 1898. Price, 5 cents .....	8,000
Reprint, May, 1898 .....	500
Section of Foreign Markets. By Frank H. Hitchcock, Chief. Pp. i-iii, 270-278, from Yearbook for 1897. May, 1898 .....	2,000
Reprint, May, 1898 .....	2,000
Hawaiian Commerce from 1887-1897. By Frank H. Hitchcock. Pp. 37. Circular No. 18. Revised edition. (Reprint.) May, 1898 .....	1,000
Our Trade with Cuba from 1887-1897. By Frank H. Hitchcock, Chief of Section of Foreign Markets. Pp. 29. Circular No. 16. (Reprint.) June, 1898.....	2,000

## CONGRESSIONAL PUBLICATIONS.

White-Pine Timber Supplies. (Letter from the Secretary of Agriculture, transmitting, in response to Senate resolution of April 14, 1897, a statement prepared by the Chief of the Division of Forestry regarding white-pine timber supplies.) Pp. 21. (Senate Doc. No. 40, 55th Cong., 1st sess.) (Reprint.) August, 1897.....	1,000
Yearbook of the Department of Agriculture, 1896. Pp. 686, pls. 6, figs. 164. July, 1897. Printed by order of Congress. Price, 50 cents.....	500,000
Annual Reports of the Department of Agriculture for the Fiscal Year ended June 30, 1897. Report of the Secretary of Agriculture, Miscellaneous Reports. Pp. 226. December, 1897.....	6,000
Possible Influence of Importation of Hawaiian Sugar on Beet-Sugar Production in the United States. (Letter from the Secretary of Agriculture in response to the Senate resolution of January 14, 1898.) Pp. 4. Circular No. 7. January, 1898.....	2,000
A Report to Congress on Agriculture in Alaska, including Reports by Walter H. Evans, Benton Killin, and Sheldon Jackson. Prepared under the supervision of A. C. True, Director of the Office of Experiment Stations. Pp. 36, pls. 23. Bulletin No. 48. February, 1898 .....	2,500
Adulteration of Wheat Flour. Prepared under direction of Dr. H. W. Wiley, Chief of Division of Chemistry, by A. J. Wedderburn, Special Agent. Pp. 42. (House Doc. No. 309, 55th Cong., 2d sess.) February, 1898.....	1,722
Operations of the Bureau of Animal Industry. (Letter from the Secretary of Agriculture, transmitting the Report of the Operations of the Bureau of Animal Industry for the fiscal year ended June 30, 1897.) Pp. 55. (House Doc. No. 227, 55th Cong., 2d sess.) April, 1898.....	1,722
Yearbook of the Department of Agriculture, 1897. Pp. 792, frontispiece, pls. 40, figs. 45. Printed by order of Congress. May, 1898. Price, 60 cents .....	500,000
Analyses of Sugar Beets Grown in Various States. By Harvey W. Wiley, Chemist. Pp. 135-160, from House Doc. No. 396, 55th Cong., 2d sess., Special Report on the Beet-Sugar Industry in the United States. May, 1898 .....	5,000



Copies.

Bibliography of the More Important Contributions to American Economic Entomology. Part VI.—The more important writings published between June 30, 1888, and December 30, 1896. Prepared under the direction of the Entomologist, by Nathan Banks, Assistant. Pp. 273. June, 1898.	1, 000
Report of the Chief of the Weather Bureau, 1896-1897. In 8 parts. Pp. 431. Charts: Part VI, 22; Part VII, 11; pls. 61. June, 1898.	4, 000

## DIVISION OF ACCOUNTS AND DISBURSEMENTS.

Report of the Chief of the Division of Accounts and Disbursements for 1897. By F. L. Evans. Pp. i-iii, 93-110, from the Report of the Secretary of Agriculture. December, 1897.	250
Reprint, January, 1898.	250

## DIVISION OF AGROSTOLOGY.

Cowpeas ( <i>Vigna catjang</i> ). By Jared G. Smith, Assistant Agrostologist. Pp. i-ii, 287-296, from Yearbook for 1896. July, 1897.	1, 500
Reprint, December, 1897.	2, 000
Reprint, April, 1898.	2, 000
Timothy in the Prairie Region. By Thomas A. Williams, Assistant, Division of Agrostology. Pp. i-ii, 147-154, figs. 29-30, from Yearbook for 1896. July, 1897.	500
Alfalfa or Lucern. By Jared G. Smith, Assistant Agrostologist. Pp. 23, figs. 3. Farmers' Bulletin No. 31. (Reprint.) August, 1897.	20, 000
Revised edition, April, 1898.	20, 000
Sorghum as a Forage Crop. By Thomas A. Williams, Assistant Agrostologist. Prepared under the direction of the Agrostologist. Pp. 20, fig. 1. Farmers' Bulletin No. 50. (Reprint.) August, 1897.	30, 000
The Soy Bean as a Forage Crop. By Thomas A. Williams, Assistant Agrostologist, under the direction of F. Lamson-Scribner, Agrostologist. With an appendix on Soy Beans as Food for Man, by C. F. Langworthy, Ph. D., Office of Experiment Stations. Pp. 23, figs. 5. Farmers' Bulletin No. 58. September, 1897.	20, 000
Revised edition, December, 1897.	10, 000
Notes on the Grasses and Forage Plants of Iowa, Nebraska, and Colorado. By L. H. Pammel, Professor of Botany in Iowa Agricultural College. Prepared under the direction of the Agrostologist. Pp. 47, figs. 12. Bulletin No. 9. October, 1897. Price, 5 cents.	4, 000
Meadows and Pastures: Formation and Cultivation in the Middle Eastern States. By Jared G. Smith, Assistant Agrostologist. Pp. 24, figs. 9. Farmers' Bulletin No. 66. December, 1897.	30, 000
The Renewing of Worn-out Prairie Pastures. By Thomas A. Williams, Assistant Agrostologist. Pp. 4, figs. 4. Circular No. 4. (Revised edition.) December, 1897.	2, 000
Report of the Agrostologist for 1897. By F. Lamson-Scribner. Pp. i-ii, 161-166, from Report of the Secretary of Agriculture. January, 1898.	250
The Cultivated Vetches. By Jared G. Smith, Assistant Agrostologist. Pp. 7, figs. 4. Circular No. 6. March, 1898.	2, 000
Reprint, April, 1898.	5, 000
Reprint, May, 1898.	3, 000
Cattle Ranges of the Southwest: A History of the Exhaustion of the Pasturage, and Suggestions for Its Restoration. By H. L. Bentley, Special Agent of the Grass Station at Abilene, Tex. Pp. 32, figs. 9. Farmers' Bulletin No. 72. April, 1898.	20, 000
A Report upon the Grasses and Forage Plants of Central Texas. By H. L. Bentley, Special Agent in Charge of Grass Experiments at Abilene, Tex. Prepared under the direction of the Agrostologist. Pp. 38, figs. 14. Bulletin No. 10. May, 1898. Price, 5 cents.	5, 000
Division of Agrostology. By F. Lamson-Scribner, Agrostologist. Pp. i-iii, 160-175, from Yearbook for 1897. May, 1898.	1, 000
Leguminous Forage Crops. By Jared G. Smith, Assistant Agrostologist. Pp. i-iii, 487-508, pl. 1, figs. 8, from Yearbook for 1897. June, 1898.	500
Lawns and Lawn Making. By F. Lamson-Scribner, Agrostologist. Pp. i-iii, 335-372, pls. 7, from Yearbook for 1897. June, 1898.	1, 500

## BUREAU OF ANIMAL INDUSTRY.

Copies.

Standard Varieties of Chickens. By George E. Howard, Secretary of National Poultry and Pigeon Association, under the Supervision of Dr. D. E. Salmon, Chief of Bureau of Animal Industry. Pp. 48, figs. 42. Farmers' Bulletin No. 51. (Reprint.) July, 1897.....	100,000
Reprint, February, 1898.....	30,000
Reprint, May, 1898.....	10,000
The Country Slaughterhouse as a Factor in the Spread of Diseases. By Ch. Wardell Stiles, Ph. D., Zoologist. Bureau of Animal Industry. Pp. i-ii, 155-166, from Yearbook for 1896. July, 1897.....	1,000
Care of Dairy Utensils. By R. A. Pearson, Assistant Chief of Dairy Division, Bureau of Animal Industry. Pp. i-ii, 431-444, from Yearbook for 1896. July, 1897.....	1,000
Some Modern Disinfectants. By E. A. de Schweinitz, Ph. D., M. D., Chief of Biochemic Division, Bureau of Animal Industry. Pp. i-ii, 255-262, figs. 58, from Yearbook for 1896. July, 1897.....	500
Preventive Vaccination against Blackleg. By Dr. D. E. Salmon, Chief of the Bureau of Animal Industry. Pp. 2. Circular No. 20. July, 1897.....	1,000
The Dairy Industry in Missouri and Kansas. By Levi Chubbuck, Special Expert Agent, Dairy Division, under the direction of Dr. D. E. Salmon, Chief of the Bureau of Animal Industry. Pp. 23, maps 2. Bulletin No. 18. July, 1897. Price, 5 cents.....	6,500
Directions for the Use of Blackleg Vaccine. By Dr. D. E. Salmon, Chief of the Bureau of Animal Industry. Pp. 8, figs. 2. Circular No. 21. August, 1897.....	3,000
The Dairy Herd: Its Formation and Management. By Henry E. Alvord, C. E., Chief of Dairy Division, Bureau of Animal Industry. Pp. 24. Farmers' Bulletin No. 55. Reprinted revision by author, from Yearbook for 1897. August, 1897.....	50,000
Reprint, February, 1898.....	30,000
Reprint, May, 1898.....	10,000
Facts About Milk. By R. A. Pearson, B. S., Assistant Chief, Dairy Division, Bureau of Animal Industry. Pp. 29, figs. 8. Farmers' Bulletin No. 42. (Reprint). August, 1897.....	30,000
Reprint, April, 1898.....	20,000
Hog Cholera and Swine Plague. By Dr. D. E. Salmon, D. V. M., Chief of the Bureau of Animal Industry. Pp. 16. Farmer's Bulletin No. 24. (Reprint.) September, 1897.....	40,000
Reprint, April, 1898.....	25,000
Reprint, June, 1898.....	10,000
Creameries or Butter Factories: Advantages, Location, Organization, and Equipment. By Henry E. Alvord, C. E., Chief of Dairy Division. Pp. i-iii, 297-316, Pls. XXXII-XXXVIII, figs. 2-4, from Twelfth and Thirteenth Annual Reports of the Bureau of Animal Industry. October, 1897.....	6,000
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Instructions for Use of Aneroid Barographs on the Great Lakes. Prepared under direction of Willis L. Moore, Chief of Weather Bureau. Pp. 7. (Weather Bureau, No. 132.) October, 1897.....	500
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Instructions to Operators on the United States Seacoast Telegraph Lines. Pp. 26. (Weather Bureau, No. 134.) November, 1897.....	200
Monthly Bulletin of the River and Flood Service for September, 1897. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Park Morrill, Forecast Official, in charge of River and Flood Service. Pp. 11, chart 1. (Weather Bureau, No. 137.) November, 1897.....	500
Meteorological Chart of the Great Lakes. Published by authority of the Secretary of Agriculture. Willis L. Moore, Chief of Weather Bureau. November, 1897.....	2,200



	Copies.
Rainfall of the United States, with Annual, Seasonal, and Other Charts. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Alfred J. Henry, Chief of Division. Pp. 58, charts 11, pls. 3. Bulletin D. (Quarto.) November, 1897.....	3, 000
United States Daily Atmospheric Survey. By Willis L. Moore, Chief of Weather Bureau. Pp. 6. (Weather Bureau, No. 138.) December, 1897. Price, 5 cents.....	500
Report of the Chief of the Weather Bureau for 1897. By Willis L. Moore. Pp. 28, from Report of the Secretary of Agriculture. (Weather Bureau, No. 139.) December, 1897.....	5, 000
Meteorological Chart of the Great Lakes. Published by authority of the Secretary of Agriculture. Willis L. Moore, Chief of Weather Bureau. December, 1897.....	2, 200
Forest and Rainfall. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by H. A. Hazen, Professor of Meteorology. Pp. 7. (Weather Bureau, No. 140.) January, 1898.....	300
The Probable State of the Sky Along the Path of Total Eclipse of the Sun, May 28, 1900. Prepared with the approval of Willis L. Moore, Chief of Weather Bureau, by Frank H. Bigelow, Professor of Meteorology. Pp. 7, chart 1. (Weather Bureau, No. 142.) January, 1898.....	300
Monthly Bulletin of the River and Flood Service for October, 1897. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Park Morrill, Forecast Official, in charge of River and Flood Service. Pp. 11, chart 1. (Weather Bureau, No. 144.) January, 1898.....	525
Monthly Bulletin of the River and Flood Service for November, 1897. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Park Morrill, Forecast Official, in charge of River and Flood Service. Pp. 13, chart 1. (Weather Bureau, No. 147.) January, 1898.....	600
Storm Bulletin No. 1, 1898. Rain, Snow, and Wind Storm of January, 24-26, 1898. January, 1898.....	3, 000
Floods of the Mississippi River. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Park Morrill, Forecast Official, in charge of River and Flood Service. Pp. 79, pls. 5, maps and diagrams 58. Bulletin No. 3. January, 1898. Price, \$1.....	2, 900
A Winter Barograph Curve from the South Pacific Ocean. By Robert DeC. Ward, Instructor in Climatology, Harvard University. Pp. 6, fig. 1. (Weather Bureau, No. 149.) February, 1898.....	50
Monthly Report of the River and Flood Service for December, 1897. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Park Morrill, Forecast Official, in charge of River and Flood Service. Pp. 13, chart 1. (Weather Bureau, No. 151.) February, 1898.....	600
Monthly Report of the River and Flood Service for January, 1898. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Park Morrill, Forecast Official, in charge of River and Flood Service. Pp. 13, chart 1. (Weather Bureau, No. 153.) February, 1898.....	600
An Improved Sunshine Recorder. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by D. T. Maring, Instrument Division. Pp. 15, figs. 3. February, 1898.....	300
The Highest Kite Ascensions at Blue Hill. Prepared with the approval of Willis L. Moore, Chief of Weather Bureau, by S. P. Ferguson. Pp. 4. February, 1898.....	150
Meteorological Chart of the Great Lakes. Published by authority of the Secretary of Agriculture. Willis L. Moore, Chief of Weather Bureau. March, 1898.....	2, 400
Meteorological Chart of the Great Lakes. Published by authority of the Secretary of Agriculture. Willis L. Moore, Chief of Weather Bureau. April, 1898.....	2, 482
Monthly Report of the River and Flood Service for February, 1898. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Park Morrill, Forecast Official, in charge of River and Flood Service. Pp. 14, chart 1. (Weather Bureau, No. 156.) April, 1898.....	650
Monthly Bulletin of the River and Flood Service for March, 1898. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Park Morrill, Forecast Official, in charge of River and Flood Service. Pp. 19, chart 1. (Weather Bureau, No. 158.) April, 1898.....	650



Copies.

Abstract of a Report on Solar and Terrestrial Magnetism in Their Relations to Meteorology. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Frank H. Bigelow, Professor of Meteorology. Pp. 176, charts 39. Bulletin No. 21. April, 1898. Price, 15 cents.....	1,000
The Weather Bureau. By Willis L. Moore. Pp. i-iii, 59-76, from Yearbook for 1897. May, 1898.....	500
Normal Annual Sunshine and Snowfall. Pp. 5, charts 2. (Weather Bureau, No. 166.) May, 1898.....	500
Report of the Chief of the Weather Bureau, 1896-97.	
Part II. Climatology. Hourly averages of Atmospheric Pressure, Temperature, and Wind from the Records of Self-Recording Instruments at twenty-eight stations; Lustrum Mean Values of Pressure, Temperature, and Wind, 1891-1895. Pp. 18-123. May, 1898.....	200
Part III. Climatology. Monthly and Annual Meteorological Summaries. Pp. 125-199. May, 1898.....	500
Part IV. Climatology. Monthly and Annual Mean Temperature and Annual Extremes of Temperature, Together with the Dates of First and Last Killing Frost. Pp. 201-234. May, 1898.....	500
Part V. Climatology. Monthly and Annual Precipitation. All Stations. Pp. 235-273. May, 1898.....	500
Part VI. Climatology. Miscellaneous Meteorological Tables. Charts and Reports, illustrating the weather of 1896. Pp. 275-313. Charts 22. May, 1898.....	500
Monthly Bulletin of the River and Flood Service for April, 1898. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Park Morrill, Forecast Official in charge of River and Flood Service. Pp. 30, chart 1. (Weather Bureau, No. 160.) May, 1898.....	650
Meteorological Chart of the Great Lakes. Published by authority of the Secretary of Agriculture. Willis L. Moore, Chief of Weather Bureau. May, 1898.....	2,500
Review of Weather and Crop Conditions, Season of 1897. By James Berry, Chief of Climate and Crop Division. Pp. i-iii, 689-709, figs. 2. from Yearbook for 1897. June, 1898.....	1,200
Monthly Bulletin of the River and Flood Service for May, 1898. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Park Morrill, Forecast Official, and Chief of Forecast Division. Pp. 14, chart 1. (Weather Bureau, No. 164.) June, 1898.....	650
Climate of Cuba: also a Note on the Weather of Manila. By W. F. R. Phillips, in charge of Section of Climatology. Prepared under direction of Willis L. Moore, Chief of Weather Bureau. Pp. 23. Bulletin No. 22. June, 1898.....	2,000
Wrecks and Casualties on the Great Lakes during 1895, 1896, and 1897. Prepared under direction of Willis L. Moore, Chief of Weather Bureau, by Norman B. Conger, Local Forecast Official and Marine Agent. Pp. 23, charts 3. June, 1898.....	3,000
Meteorological Chart of the Great Lakes. Published by authority of the Secretary of Agriculture. Willis L. Moore, Chief of Weather Bureau. June, 1898.....	2,630
Climate and Crop Bulletin No. 17. July 5, 1897.....	4,000
Climate and Crop Bulletin No. 18. July 12, 1897.....	4,000
Climate and Crop Bulletin No. 19. July 19, 1897.....	4,000
Climate and Crop Bulletin No. 20. July 26, 1897.....	4,000
Climate and Crop Bulletin No. 21. August 2, 1897.....	3,850
Climate and Crop Bulletin No. 22. August 9, 1897.....	4,000
Climate and Crop Bulletin No. 23. August 16, 1897.....	4,000
Climate and Crop Bulletin No. 24. August 23, 1897.....	4,000
Climate and Crop Bulletin No. 25. August 30, 1897.....	4,000
Climate and Crop Bulletin No. 26. September 6, 1897.....	4,000
Climate and Crop Bulletin No. 27. September 13, 1897.....	4,000
Climate and Crop Bulletin No. 28. September 20, 1897.....	4,000
Climate and Crop Bulletin No. 29. September 27, 1897.....	4,000
Climate and Crop Bulletin No. 30. October, 1897.....	4,066
Climate and Crop Bulletin No. 31. November, 1897.....	4,000
Climate and Crop Bulletin No. 32. December, 1897.....	4,000
Climate and Crop Bulletin No. 1. January, 1898.....	4,000
Climate and Crop Bulletin No. 2. February, 1898.....	4,000

	Copies.
Climate and Crop Bulletin No. 3. March, 1898.....	4,000
Climate and Crop Bulletin No. 4. April 11, 1898.....	4,000
Climate and Crop Bulletin No. 5. April 18, 1898.....	4,000
Climate and Crop Bulletin No. 6. April 25, 1898.....	4,000
Climate and Crop Bulletin No. 7. May 2, 1898.....	4,000
Climate and Crop Bulletin No. 8. May 9, 1898.....	4,000
Climate and Crop Bulletin No. 9. May 16, 1898.....	4,000
Climate and Crop Bulletin No. 10. May 23, 1898.....	4,100
Climate and Crop Bulletin No. 11. May 30, 1898.....	4,200
Climate and Crop Bulletin No. 12. June 6, 1898.....	4,200
Climate and Crop Bulletin No. 13. June 13, 1898.....	4,400
Climate and Crop Bulletin No. 14. June 20, 1898.....	4,400
Climate and Crop Bulletin No. 15. June 27, 1898.....	4,400
Snow and Ice Chart. December 6, 1897.....	1,500
Snow and Ice Chart. December 13, 1897.....	1,550
Snow and Ice Chart. December 20, 1897.....	1,650
Snow and Ice Chart. December 27, 1897.....	1,600
Snow and Ice Chart. January 3, 1898.....	1,600
Snow and Ice Chart. January 10, 1898.....	1,600
Snow and Ice Chart. January 17, 1898.....	1,600
Snow and Ice Chart. January 24, 1898.....	1,600
Snow and Ice Chart. January 31, 1898.....	1,548
Snow and Ice Chart. February 7, 1898.....	1,800
Snow and Ice Chart. February 14, 1898.....	1,800
Snow and Ice Chart. February 21, 1898.....	1,800
Snow and Ice Chart. February 28, 1898.....	1,800
Snow and Ice Chart. March 7, 1898.....	1,680
Snow and Ice Chart. March 14, 1898.....	1,680
Snow and Ice Chart. March 21, 1898.....	1,800
Snow and Ice Chart. March 28, 1898.....	1,800
Daily Weather Map (showing weather conditions throughout the United States and giving forecasts of probable changes):	
July, 1897.....	24,800
August, 1897.....	24,800
September, 1897.....	24,800
October, 1897.....	24,800
November, 1897.....	24,800
December, 1897.....	24,800
January, 1898.....	24,800
February, 1898.....	24,800
March, 1898.....	24,800
April, 1898.....	24,800
May, 1898.....	24,800
June, 1898.....	24,155

## APPENDIX B.

## REPORT IN DETAIL OF PUBLICATIONS OF THE U. S. DEPARTMENT OF AGRICULTURE RECEIVED AND DISTRIBUTED DURING FISCAL YEAR ENDED JUNE 30, 1898.

[NOTE.—The publications of the Weather Bureau are not distributed from the Division of Publications, but by an official in that bureau specially charged with such work and directed by the order of the Secretary of Agriculture, dated March 29, 1897, to report to the chief of this division. A list of Weather Bureau publications is given in separate tables.]

*Publications received and distributed from July 1, 1897, to June 30, 1898.*

Title of publication.	Received.	Distributed.
Bulletin No. 41, Office of Experiment Stations	2,000	1,921
Circular No. 17, Section of Foreign Markets	10,000	8,387
Bulletin No. 18, Bureau of Animal Industry	6,500	6,579
Circular No. 35, Office of Experiment Stations	3,000	2,560
Experiment Station Record, Vol. VIII, No. 10	4,010	3,988
Bulletin No. 6, technical series, Division of Entomology	1,578	1,486
Crop Report for July, 1897, No. 150	191,800	191,237
Bulletin No. 16, Library	750	22
Circular No. 24, Division of Entomology	2,000	1,315
Circular No. 18, Section of Foreign Markets	11,000	6,998
Circular No. 25, Division of Entomology	2,000	1,406
Extract from Experiment Station Record, Vol. VIII, Nos. 9 and 10	200	102
Circular No. 37, Office of Experiment Stations	5,000	3,022
Circular No. 1, Office of Gardens and Grounds	4,000	1,374
Crop Report for August, 1897, No. 151	196,400	196,400
Circular No. 21, Bureau of Animal Industry	3,000	1,508
Circular No. 12, Division of Botany	10,000	8,802
National Herbarium, Vol. V, No. 3	2,500	1,990
Bulletin No. 17, Library	750	11
Circular No. 26, Division of Entomology	5,000	1,446
Circular No. 16, Division of Forestry	5,000	4,604
Proceedings of the National Convention for Suppression of Insects	2,000	1,916
Crop Report for September, 1897, No. 152	197,000	197,000
Bulletin No. 9, Office of Fiber Investigations	1,000	868
Experiment Station Record, Vol. VIII, No. 11	4,000	3,864
Bulletin No. 2, Division of Publications	1,074	633
Bulletin No. 9, Division of Soils	1,545	1,545
Bulletin No. 14, Division of Vegetable Physiology and Pathology	1,649	1,649
Agricultural Associations in Belgium, from Experiment Station Record	1,000	399
Experiment Station Record, Vol. IX, No. 1	4,056	3,990
Circular No. 28, Division of Entomology	2,500	775
Bulletin No. 11, new series, Division of Entomology	3,600	1,971
Bulletin No. 20, Library	2,000	1,074
Circular No. 4, Division of Chemistry	1,000	526
Experiment Station Record, Vol. IX, No. 4	4,500	4,090
Circular No. 6, Office of the Secretary	3,000	1,915
Circular No. 7, Office of the Secretary	2,000	1,249
Experiment Station Record, Vol. IX, No. 5	4,500	4,108
Circular No. 8, Division of Statistics	27,000	24,666
Bulletin No. 19, Bureau of Animal Industry	6,000	4,075
Report of Chief of Division of Road Inquiry, 1897	600	600
Report of Chief of Division of Agrostology, 1897	250	202
Report of Chief of Division of Botany, 1897	500	468
Report of Chief of Division of Pomology, 1897	400	309
Report of Chief of Bureau of Animal Industry, 1897	1,000	255
Report of Chief of Division of Forestry, 1897	1,000	207
Report of Chief of Division of Soils, 1897	250	200
Report of Chief of Division of Accounts and Disbursements, 1897	500	200
Report Special Agent Fiber Investigations, 1897	250	201
Report of Chief of Division of Biological Survey, 1897	100	52
Report of Chief of Division of Chemistry, 1897	500	400
Report of Chief of Section of Foreign Markets, 1897	250	200
Report of Chief of Division of Entomology, 1897	250	202
Report of Chief of Vegetable Physiology and Pathology, 1897	250	151
Report of Chief of Division of Publications, 1897	3,900	857
Report of Director of Office of Experiment Stations, 1897	2,000	1,590
Report of the Statistician, 1897	5,260	5,256
Yearbook of the U. S. Department of Agriculture, 1896	30,000	24,360
Bulletin No. 21, Office of Experiment Stations	1,000	630
Bulletin No. 16, Division of Botany (reprint)	6,075	3,633
Bulletin No. 13, Division of Forestry (reprint)	1,000	576
Bulletin No. 3, Division of Entomology (reprint)	3,000	555
Circular No. 17, Division of Biological Survey (reprint)	12,000	2,281



*Publications received and distributed, etc.—Continued.*

Title of publication.	Received.	Distrib- uted.
Bulletin No. 16, Office of Road Inquiry (reprint) .....	5,000	937
Yearbook of the U. S. Department of Agriculture, 1897 .....	20,248	18,038
Bulletin No. 5, Division of Pomology (reprint) .....	1,075	41
Circular No. 16, Section of Foreign Markets (reprint) .....	2,200	140
Bulletin No. 46, Office of Experiment Stations (reprint) .....	4,000	2,886
Bulletin No. 48, Office of Experiment Stations (reprint) .....	2,520	2,206
Bulletin No. 21, Library .....	900	880
Bulletin No. 11, Division of Soils .....	3,000	2,789
Bulletin No. 50, Office of Experiment Stations .....	2,000	1,998
Circular No. 20, Section of Foreign Markets .....	65,000	63,571
Bulletin No. 10, Section of Foreign Markets .....	20,100	15,756
Circular No. 30, Office of Road Inquiry .....	10,000	1,387
Bulletin No. 45, Office of Experiment Stations .....	1,025	1,023
Circular No. 6, Division of Agrostology .....	10,000	9,001
Reprint from Experiment Station Record, Vol. IX, No. 6 .....	500	391
Experiment Station Record, Vol. IX, No. 6 .....	4,500	4,044
Experiment Station Record, Vol. IX, No. 7 .....	4,505	3,773
Bulletin No. 12, new series, Division of Entomology .....	5,500	3,088
Bulletin No. 15, Division of Forestry .....	5,000	4,618
Circular No. 23, Bureau of Animal Industry .....	5,000	4,632
Bulletin No. 10, Division of Entomology .....	3,520	1,230
Bulletin No. 12, Division of Soils .....	2,025	1,301
Bulletin No. 49, Office of Experiment Stations .....	2,000	1,941
Bulletin No. 13, new series, Division of Entomology .....	3,000	1,762
Circular No. 22, Bureau of Animal Industry .....	5,000	2,608
Circular No. 29, Division of Entomology .....	5,000	1,748
Bulletin No. 51, Office of Experiment Stations .....	3,025	2,184
Circular No. 30, Division of Entomology .....	7,000	6,385
Experiment Station Record, Vol. IX, No. 8 .....	4,510	3,884
Bulletin No. 9, Division of Agrostology .....	4,050	2,489
Bulletin No. 7, technical series, Division of Entomology .....	1,604	1,604
Circular No. 31, Office of Experiment Stations .....	500	400
Circular No. 17, Division of Forestry .....	5,500	5,417
Crop Report for October, 1897, No. 153 .....	195,200	194,611
North American Fauna, No. 13 .....	2,585	2,585
Experiment Station Record, Vol. IX, No. 2 .....	4,055	4,054
Bulletin No. 6, Division of Pomology .....	17,155	15,674
Bulletin No. 43, Office of Experiment Stations .....	4,550	4,522
Circular No. 10, Dairy Division, Bureau of Animal Industry .....	6,000	5,583
Bulletin No. 9, Division of Entomology .....	2,000	1,241
Bulletin No. 44, Office of Experiment Stations .....	2,550	1,578
Experiment Station Record, Vol. VIII, Bd. .....	200	166
Bulletin No. 43, Division of Chemistry (reprint) .....	500	315
Bulletin No. 36, Division of Chemistry (reprint) .....	500	473
Bulletin No. 47, Division of Chemistry (reprint) .....	500	202
Bulletin No. 31, Division of Chemistry (reprint) .....	500	271
Circular No. 19, Section of Foreign Markets .....	10,000	4,311
Preliminary Report of Secretary of Agriculture, 1897 .....	30,825	13,110
Crop Report for November, 1897, No. 154 .....	196,000	195,887
Bulletin No. 19, Library .....	1,000	944
Annual Report of the Secretary of Agriculture, 1897 .....	3,000	2,310
Circular No. 13, Division of Botany .....	8,000	7,151
Bulletin No. 47, Office of Experiment Stations .....	3,545	1,997
Circular No. 1, Bureau of Animal Industry .....	1,000	680
Experiment Station Record, Vol. VIII, No. 12 .....	4,500	4,017
Bulletin No. 10, Division of Soils .....	2,000	1,961
Circular No. 13, Division of Entomology .....	2,000	598
Circular No. 3, Division of Pomology .....	1,000	725
Bulletin No. 8, Division of Biological Survey .....	2,515	1,729
Experiment Station Record, Vol. IX, No. 3 .....	4,500	3,886
Circular No. 5, Division of Agrostology .....	4,000	2,577
Extract from Experiment Station Record, Vol. IX, No. 8 .....	2,100	109
Bulletin No. 20, Bureau of Animal Industry .....	10,000	5,672
Bulletin No. 11, Section of Foreign Markets .....	8,535	8,290
Final Crop Report for 1897, No. 155 .....	92,100	78,527
Bulletin No. 12, Section of Foreign Markets .....	8,634	8,242
Circular No. 14, Division of Botany .....	5,000	3,415
Circular No. 31, Division of Entomology .....	4,000	1,776
Circular No. 18, Division of Forestry .....	5,060	4,992
Experiment Station Record, Vol. IX, No. 9 .....	4,525	3,975
Bulletin No. 22, Library .....	895	895
Miscellaneous Bulletin No. 13, Division of Statistics .....	24,975	24,975
Bulletin No. 3, Division of Publications .....	5,000	4,544
Crop Circular for May, 1898 .....	199,000	195,638
Bulletin No. 19, Division of Botany .....	4,050	3,866
Bulletin No. 10, Division of Agrostology .....	5,025	3,395
Experiment Station Record, Vol. IX, No. 10 .....	4,515	4,115
Reprint from Experiment Station Record, Vol. IX, No. 10 .....	200	25
Bulletin No. 52, Office of Experiment Stations .....	4,100	1,742
Bulletin No. 16, Division of Forestry .....	5,000	3,687
Miscellaneous Bulletin No. 14, Division of Statistics .....	15,350	3,339
Bibliography of the More Important Contributions to Entomology .....	1,020	844



*Publications received and distributed, etc.—Continued.*

Title of publication.	Received.	Distrib- uted.
Analysis of Sugar Beets (reprint, House Doc. 396).....	5,000	4,952
Experiment Station Record, Vol. IX, No. 11.....	4,005	4,004
Bulletin No. 53, Office of Experiment Stations.....	4,000	3,138
House Document No. 396, Beet-Sugar Industry.....	544	544
Reprint from Experiment Station Record, Vol. IX, No. 11.....	200	58
Crop Circular for June, 1898.....	199,200	198,831
Index to Statistical Reports, Nos. 145 to 155.....	11,650	220
Bulletin No. 13, Division of Soils.....	5,000	1,706
Bulletin No. 15, Division of Vegetable Physiology and Pathology.....	15,040	2,968
Circular No. 15, Division of Botany.....	5,000	2,714
Circular No. 20, Division of Forestry.....	2,500	1,509
Bulletin No. 51, Division of Chemistry.....	1,000	871
From Yearbook of 1897:		
Review of Weather Crop Conditions.....	12,300	11,500
Hybrids and their Utilization in Plants.....	5,000	746
Utilization of By-Products of the Dairy.....	10,150	500
Trees Important in Forestry.....	2,500	2,500
Agricultural Outlook of Alaska Coast Region.....	1,000	1,000
Some Interesting Soil Problems.....	1,500	1,074
Lawns and Lawn Making.....	1,500	624
Agricultural Production and Prices.....	500	500
Needs and Requirements of a Control of Feed Stuffs.....	2,500	100
Foods for Man.....	1,000	100
Leguminous Forage Crops.....	500	377
Flax Culture in the United States.....	500	50
Additional Notes on Seed Testing.....	500	364
Birds that Injure Grain.....	1,000	255
Popular Education for the Farmer in the United States.....	1,000	-----
Every Farm an Experiment Station.....	100	100
Office of Road Inquiry.....	10,000	1
Bureau of Animal Industry.....	5,060	2,924
Office of Fiber Investigations.....	500	100
Division of Publications.....	1,000	726
Division of Agrostology.....	1,000	359
Division of Pomology.....	200	200
Division of Soils.....	500	462
Experimental Gardens and Grounds.....	300	202
The Library.....	500	43
Section of Foreign Markets.....	4,100	3,772
Division of Entomology.....	100	100
Division of Vegetable Physiology and Pathology.....	1,000	617
Office of Experiment Stations.....	500	102
Division of Forestry.....	2,500	2,496
Division of Botany.....	500	201
Division of Chemistry.....	100	100
Number distributed of publications received prior to July 1, 1897.....	-----	1,105,758
Total number miscellaneous received and distributed.....	2,263,861	3,113,797

*Farmers' Bulletins printed, and Congressional and miscellaneous distribution, for the fiscal year 1897-1898.*

No. of bulletin.	Title of publication.	Total number received.	Distrib- uted to Congress- men.	Miscella- neous dis- tribution.
58	The Soy Bean.....	30,100	5,823	12,645
59	Bee Keeping.....	50,275	29,236	11,959
60	Methods of Curing Tobacco.....	40,200	23,930	7,734
61	Asparagus Culture.....	20,200	8,865	9,124
62	Marketing Farm Produce.....	40,235	22,314	9,905
63	Care of Milk on the Farm.....	80,235	22,504	54,148
64	Ducks and Geese.....	60,375	47,309	12,293
65	Experiment Station Work.....	30,200	15,790	9,586
66	Meadows and Pastures.....	30,000	14,176	11,883
67	Forestry for Farmers.....	20,070	8,706	5,093
68	Black Rot of the Cabbage.....	30,350	8,467	9,229
69	Experiment Station Work.....	20,350	5,069	15,128
70	Principal Insect Enemies of Grape.....	20,000	5,609	4,036
71	Some Essentials in Beef Production.....	50,300	6,589	3,437
72	Cattle Ranges of the Southwest.....	20,000	3,218	5,986
73	Experiment Station Work.....	20,100	9,450	5,389
74	Milk as Food.....	20,000	7,285	4,089
75	The Grain Smuts.....	50,000	7,002	10,736
77	The Liming of Soils.....	20,050	3,106	1,311
78	Experiment Station Work.....	10,100	4,329	2,996

*Farmers' Bulletins printed, and Congressional and miscellaneous distribution, for the fiscal year 1897-1898—Continued.*

No. of bulletin.	Title of publication.	Total number received.	Distributed to Congressmen.	Miscellaneous distribution.
REPRINTS.				
6	Tobacco.....		1,963	1,526
11	Rape Plant.....		70	698
14	Fertilizers for Cotton.....		25	614
15	Some Destructive Potato Diseases.....	50,200	31,102	8,715
16	Leguminous Plants.....	20,000	17,402	9,901
17	Peach Yellows and Peach Rosette.....		614	1,664
18	Forage Plants for the South.....		18,589	4,589
19	Important Insecticides.....	30,000	20,777	11,840
20	Washed Soils.....	10,100	12,262	4,999
21	Barnyard Manure.....	42,950	38,315	9,799
22	The Feeding of Farm Animals.....	61,440	57,478	12,371
23	Foods.....	5,100	9,499	11,583
24	Hog Cholera and Swine Plague.....	75,600	69,219	10,986
25	Peanuts.....	5,200	792	3,850
26	Sweet Potatoes.....	10,600	14,552	6,035
27	Flax for Seed and Fiber in the United States.....	20,050	5,613	3,192
28	Weeds.....	30,550	22,490	9,693
29	Souring of Milk.....	22,375	18,744	7,444
30	Grape Diseases on the Pacific Coast.....	10,150	2,637	2,587
31	Alfalfa, or Lucern.....	40,250	18,327	7,477
32	Silos and Silage.....	20,350	12,135	8,591
33	Peach Growing for Market.....	30,250	25,061	7,333
34	Meats.....	10,250	19,768	8,768
35	Potato Culture.....	50,500	53,303	13,675
36	Cotton Seed and Its Products.....	10,325	13,067	3,292
37	Kafir Corn.....	20,000	10,356	5,154
38	Spraying for Fruit Diseases.....	50,125	26,458	10,121
39	Onion Culture.....	20,400	23,262	8,379
40	Farm Drainage.....	10,400	17,603	5,858
41	Fowls.....	102,625	84,746	16,568
42	Facts About Milk.....	50,950	46,284	16,438
43	Sewage.....	10,500	12,745	4,381
44	Commercial Fertilizers.....	50,725	43,702	6,942
45	Some Insects Injurious to Stored Grain.....	20,400	21,062	4,695
46	Irrigation in Humid Climates.....	10,050	6,930	3,792
47	Insects Affecting Cotton Plant.....	25,450	24,338	4,411
48	The Manuring of Cotton.....	10,200	27,132	3,039
49	Sheep Feeding.....	40,550	34,694	6,536
50	Sorghum as a Forage Crop.....	30,030	21,553	4,576
51	Standard Varieties of Chickens.....	139,975	118,188	23,064
52	The Sugar Beet.....	90,485	69,454	26,205
53	How to Grow Mushrooms.....		9,452	47,516
54	Some Common Birds.....	50,259	43,983	9,591
55	The Dairy Herd.....	90,300	49,394	34,033
56	Experiment Station Work.....	90,300	52,153	51,001
57	Butter Making on the Farm.....	41,165	91,929	23,656
	Total.....	2,174,269	1,580,065	694,385
	Total aggregate distribution.....			2,274,350

*a* The distribution through Members of Congress and to miscellaneous applicants includes many copies carried over from previous years

*Weather Bureau publications issued during the fiscal year ended June 30, 1898.*

	Title of publication.	Number of copies.
No. 122.	A Monograph on the Mechanics and Equilibrium of Kites.....	1,000
No. 123.	Monthly Weather Review for May, 1897.....	4,000
No. 124.	The Standard System of Coordinate Axes for Magnetic and Meteorological Observations and Computations.....	200
No. 125.	Wind Barometer Table.....	500
No. 126.	Clothing and Temperature.....	525
No. 127.	Tables for Obtaining the Temperature of the Dew Point, Relative Humidity, etc.....	713
No. 128.	Monthly Weather Review for June, 1897.....	4,000
No. 129.	Monthly Weather Review for July, 1897.....	3,817
No. 130.	Equations of Hydrodynamics.....	500
No. 131.	Monthly Weather Review for August, 1897.....	4,000
No. 132.	Instructions for Aneroid Barograph on the Great Lakes.....	500
No. 133.	Instructions Governing the Corn, Wheat, Sugar, and Rice Region Service.....	1,000
No. 134.	Instructions to Operators on the United States Seacoast Telegraph Lines.....	200
No. 135.	Monthly Weather Review for September, 1897.....	4,000
No. 136.	Bulletin D. Rainfall of the United States.....	3,000
No. 137.	Monthly Bulletin of the River and Flood Service, September, 1897.....	500
No. 138.	United States Daily Atmospheric Survey.....	500

*Weather Bureau publications issued during the fiscal year, etc.—Continued.*

Title of publication.	Number of copies.
No. 139. Report of the Chief of the Weather Bureau for 1897, pamphlet.....	5,000
No. 140. Forest and Rainfall.....	300
No. 141. Monthly Weather Review for October, 1897.....	4,000
No. 142. The Probable State of the Sky Along the Path of Total Eclipse of the Sun, May 28, 1900.....	300
No. 143. Bulletin E. Floods of the Mississippi River.....	2,900
No. 144. Monthly Bulletin of the River and Flood Service, October, 1897.....	525
No. 145. The Highest Kite Ascensions at Blue Hill.....	150
No. 146. Monthly Weather Review, November, 1897.....	4,000
No. 147. Monthly Bulletin of the River and Flood Service, November, 1897.....	600
No. 148. An Improved Sunshine Recorder.....	300
No. 149. A Winter Barograph Curve from the South Pacific Ocean.....	50
No. 150. Abstract of a Report on Solar and Terrestrial Magnetism in Their Relations to Meteorology.....	1,000
No. 151. Monthly Report of the River and Flood Service for December, 1897.....	600
No. 152. Monthly Weather Review for December, 1897.....	4,000
No. 153. Monthly Report of the River and Flood Service, January, 1898.....	600
No. 154. Monthly Weather Review and Annual Summary for 1897.....	4,000
No. 155. Monthly Weather Review for January, 1898.....	4,000
No. 156. Monthly Report of the River and Flood Service for February, 1898.....	650
No. 157. Monthly Weather Review for February, 1898.....	4,000
No. 158. Monthly Bulletin of the River and Flood Service for March, 1898.....	650
No. 159. Wrecks and Casualties on the Great Lakes during 1895, 1896, and 1897.....	3,000
No. 160. Monthly Bulletin of the River and Flood Service for April, 1898.....	650
No. 161. Monthly Weather Review for March, 1898.....	4,000
No. 162. Normal Annual Sunshine and Snowfall.....	500
No. 163. Climate of Cuba; also a Note on the Weather of Manila.....	2,000
No. 164. Monthly Bulletin of the River and Flood Service for May, 1898.....	650
No. 165. Monthly Weather Review for April, 1898.....	4,000
No. 166. Instructions for Aerial Observers, Circular K, Instrument Division.....	500
Description of Cloud Forms (third edition).....	4,000
Meteorological Chart of the Great Lakes, October, November, and December, 1897, and March, April, May, and June, 1898.....	14,412
Snow and Ice Chart.....	28,408
Storm Bulletin, No. 1, 1898. Rain, Snow, and Wind Storm of January 24-26, 1898.....	3,000
Part II. Climatology. Report of the Chief of the Weather Bureau for 1896-97.....	200
Part III. Climatology. Report of the Chief of the Weather Bureau for 1896-97.....	500
Part IV. Climatology. Report of the Chief of the Weather Bureau for 1896-97.....	500
Part V. Climatology. Report of the Chief of the Weather Bureau for 1896-97.....	500
Part VI. Climatology. Report of the Chief of the Weather Bureau for 1896-97.....	500
Washington Daily Weather Maps.....	296,955
Climate and Crop Bulletin of the Weather Bureau.....	129,616

*Weather Bureau publications distributed during the year ended June 30, 1898.*

Title of publication.	Number of copies.
Annual Report of the Chief of the Weather Bureau, 1891-92.....	21
Annual Report of the Chief of the Weather Bureau, 1893.....	30
Annual Report of the Chief of the Weather Bureau, 1894.....	35
Annual Report of the Chief of the Weather Bureau, 1895-96.....	152
Annual Report of the Chief of the Weather Bureau, 1896-97.....	63
Extracts from the Annual Report of the Chief of the Weather Bureau for 1891-92, 1893, 1894, 1895-96, and 1896-97.....	6,679
Description of Cloud Forms (second and third editions).....	3,780
Certain Climatic Features of the Two Dakotas.....	17
Experiment Station Bulletin No. 10, Meteorological Work for Agricultural Institutions.....	4
Departures from Normal Temperature and Rainfall with Crop Yields in Nebraska (W. B. 85).....	377
Climate and Health.....	80
Some Climatic Features of the Arid Regions.....	12
Weather Bureau Weather Code for 1896.....	205
What Meteorology is doing for the Farmer.....	3
Instructions for Voluntary Observers, 1897.....	1,077
Injury from Frost and Methods of Protection (W. B. 81).....	6
Instructions to Special River Observers.....	52
Studies of Weather Types and Storms.....	21
Instructions to Wind Signal Displaymen.....	307
Instructions to Special Displaymen.....	42
Circular of Information to the Display of Wind Signals on the Great Lakes.....	68
Extracts from Weather Bureau Bulletin No. 11, Part III.....	1,054
Circular A, Instrument Division.....	12
Circular B, Instrument Division.....	400
Circular F, Instrument Division.....	425
Circular G, Instrument Division.....	307
Daily River Stages of the Principal Rivers of the United States.....	6
The Weather Bureau (reprint from Yearbook, 1897).....	500
Review of Weather and Crop Conditions, Seasons of 1897 (reprint from Yearbook, 1897).....	11,000



*Weather Bureau publications distributed during the year, etc.—Continued.*

Title of publication.	Number of copies.
Special Report of the Chief of the Weather Bureau for 1891, pamphlet.....	23
Pamphlet Report of the Chief of the Weather Bureau, 1892.....	193
Pamphlet Report of the Chief of the Weather Bureau, 1893.....	245
Pamphlet Report of the Chief of the Weather Bureau, 1895.....	145
Pamphlet Report of the Chief of the Weather Bureau, 1896.....	215
Pamphlet Report of the Chief of the Weather Bureau, 1897.....	4,868
Monthly Weather Reviews, bound, for 1892, 1893, 1894, 1895, and 1896.....	692
Monthly Weather Reviews for various months and years.....	14,659
Bulletin A.....	12
Bulletin C.....	55
Bulletin D. (See W. B. 136.).....	
Bulletin E. (See W. B. No. 143.).....	
Bulletin No. 5.....	1
Bulletin No. 10.....	17
Bulletin No. 11, Part III.....	44
Bulletin No. 12.....	23
Bulletin No. 13.....	28
Bulletin No. 14.....	205
Bulletin No. 15 (See Circular Protection Lightning).....	431
Bulletin No. 16.....	37
Bulletin No. 17.....	1
Bulletin No. 18.....	202
Bulletin No. 19.....	205
Bulletin No. 20.....	33
Bulletin No. 21.....	912
Bulletin No. 22.....	2,000
Extracts from the Monthly Weather Reviews, Nos. 124, 125, and 126.....	403
No. 122. A Monograph on the Mechanics and Equilibrium of Kites.....	633
No. 123. Monthly Weather Review for May, 1897.....	3,864
No. 124. The Standard System of Coordinate Axes for Magnetic and Meteorological Observations and Computations.....	200
No. 125. Wind Barometer Tables.....	340
No. 126. Clothing and Temperature.....	340
No. 127. Tables for obtaining the Temperature of the Dew Point, Relative Humidity, etc.....	588
No. 128. Monthly Weather Review for June, 1897.....	3,900
No. 129. Monthly Weather Review for July, 1897.....	3,767
No. 130. The Equations of Hydrodynamics.....	316
No. 131. Monthly Weather Review for August, 1897.....	3,875
No. 132. Instructions for Use of Aneroid Barograph on the Great Lakes.....	500
No. 133. Instructions Governing the Corn, Wheat, Cotton, Sugar and Rice Region Service.....	1,000
No. 134. Instructions to Operators on the United States Seacoast Telegraph Lines.....	200
No. 135. Monthly Weather Review for September, 1897.....	3,879
No. 136. Bulletin D, Rainfall of the United States.....	2,085
No. 137. Monthly Bulletin of River and Flood Service.....	500
No. 138. United States Daily Atmospheric Survey.....	475
No. 139. (See Report of Chief of Bureau for 1897.).....	
No. 140. Forests and Rainfall.....	150
No. 141. Monthly Weather Review for October, 1897.....	3,876
No. 142. The Probable State of the Sky Along the Path of Total Eclipse of the Sun, May 28, 1900.....	300
No. 143. Bulletin E, Floods of the Mississippi River.....	2,619
No. 144. Monthly Report of the River and Flood Service for October, 1897.....	525
No. 145. The Highest Kite Ascensions at Blue Hill.....	50
No. 146. Monthly Weather Review for November, 1897.....	3,930
No. 147. Monthly Report of the River and Flood Service for November, 1897.....	600
No. 148. An Improved Sunshine Recorder.....	100
No. 149. A Winter Barograph Curve from the South Pacific Ocean.....	100
No. 150. (See Weather Bureau Bulletin 21.).....	
No. 151. Monthly Weather Report of the River and Flood Service for December, 1897.....	600
No. 152. Monthly Weather Review for December, 1897.....	3,852
No. 153. Monthly Report of the River and Flood Service for January, 1898.....	600
No. 154. Monthly Weather Review and Annual Summary for the year 1897.....	3,766
No. 155. Monthly Weather Review for January, 1898.....	3,760
No. 156. Monthly Report of the River and Flood Service for February, 1898.....	600
No. 157. Monthly Weather Review for February, 1898.....	3,670
No. 158. Monthly Bulletin of the River and Flood Service for March, 1898.....	562
No. 159. Wrecks and Casualties on the Great Lakes during 1895, 1896, and 1897.....	2,773
No. 160. Monthly Bulletin of the River and Flood Service for April, 1898.....	616
No. 161. Monthly Weather Review for March, 1898.....	3,872
No. 162. Normal Annual Sunshine and Snowfall.....	500
No. 163. Climate of Cuba. (See Weather Bureau Bulletin No. 22.).....	
No. 164. Monthly Bulletin of the River and Flood Service for May, 1898.....	608
No. 165. Monthly Weather Review for April, 1898.....	3,876
Washington Daily Weather Maps.....	293,484
Climate and Crop Bulletin of the United States.....	128,136
Snow and Ice Chart.....	27,688
Meteorological Chart of the Great Lakes, October, November, and December, 1897, and March, April, May, and June, 1898.....	14,362

[NOTE.—The publications in the above table were distributed to colleges, libraries, voluntary observers, Weather Bureau stations, foreign exchanges, and to persons making application for them from time to time.]



## REPORT OF THE CHIEF OF THE DIVISION OF ACCOUNTS AND DISBURSEMENTS.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF ACCOUNTS AND DISBURSEMENTS,  
*Washington, D. C., July 28, 1898.*

SIR: In compliance with your letter of June 11 ultimo, I have the honor to submit herewith a brief report of the work of this division for the year ending June 30, 1898.

Respectfully,

F. L. EVANS,  
*Chief.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

#### APPROPRIATIONS AND EXPENDITURES.

The act making appropriations for the United States Department of Agriculture for the fiscal year ending June 30, 1898, provided \$3,182,902, including \$720,000 for agricultural experiment stations. To this sum was added \$5,000 for "domestic sugar production" in the sundry civil bill approved June 4, 1898.

Of the total amount thus appropriated, exclusive of the agricultural experiment stations fund, \$2,245,334.08 was expended during the fiscal year 1898. On the 1st of July, 1898, there remained unpaid bills amounting to \$170,000, leaving a final balance to cover back into the United States Treasury of, in round numbers, \$52,000. The total expenditures for the year, including the payment of supplemental accounts for the years 1896 and 1897, were \$2,411,960.85.

The following table presents in detail the appropriations for 1898, the amounts disbursed during the year, and the unexpended balances on June 30, 1898:

*Appropriations, disbursements, and amount unexpended for the fiscal year 1898.*

Object.	Appropriations. 1898.	Total appropriations.	Amount of warrants.	Amount disbursed.	Amount unexpended.
Salaries, officers and clerks .....	\$290,300	\$319,300.00	\$315,000.00	\$284,975.30	\$5,324.70
Messengers, laborers, and mechanics .....	19,000			18,962.98	37.02
Additional assistants in laboratory .....	10,000			9,811.02	188.98
Furniture, cases, and repairs, Department of Agriculture .....		9,000.00	8,300.00	7,812.90	1,187.10
Library, Department of Agriculture .....		7,000.00	4,800.00	4,419.93	2,580.07
Museum, Department of Agriculture .....		3,000.00	2,900.00	2,906.02	93.98
Postage, Department of Agriculture .....		3,000.00	1,500.00	1,500.00	1,500.00
Contingent expenses, Department of Agriculture .....		25,000.00	22,115.22	20,772.63	4,227.37
Animal quarantine stations .....		12,000.00	9,800.00	9,679.26	2,320.74
Collecting agricultural statistics .....	100,000	110,000.00	104,002.75	91,388.59	8,611.41
Investigating foreign demands for United States agricultural products .....					
Botanical investigations and experiments .....	10,000			9,021.09	978.91
Entomological investigations .....		15,000.00	14,800.00	14,432.77	567.23
Vegetable pathological investigations .....		20,000.00	17,000.00	17,088.60	2,911.40
Rent of building .....	19,340	20,000.00	19,600.00	18,255.98	1,084.02
Biological investigations .....	660			605.00	55.00
Pomological investigations .....		17,500.00	16,080.15	15,782.40	1,717.60
Laboratory, Department of Agriculture .....		8,000.00	7,700.00	7,149.76	850.24
Rent of building .....	4,000	12,400.00	12,000.00	3,628.16	371.84
Adulteration of food .....	900			825.00	75.00
Forestry investigations .....	7,500			6,702.96	797.04
Experimental gardens and grounds, Department of Agriculture .....		20,000.00	18,620.37	18,047.77	1,952.23
Soil investigations .....		25,000.00	25,000.00	24,320.37	679.63
Rent of building .....	9,340	10,000.00	9,389.35	8,473.11	866.89
Grass and forage plant investigations .....	660			605.00	55.00
Fiber investigations .....		10,000.00	8,941.80	8,538.72	1,461.28
Agricultural experiment stations [§755,000] <sup>a</sup> .....	35,000	5,000.00	3,900.00	3,584.15	1,415.85
Nutrition investigations .....		35,000.00	32,926.42	32,576.54	2,423.46
Public road inquiries .....		15,000.00	11,500.00	10,975.67	4,024.33
Publications, Farmers' Bulletins .....		8,000.00	7,900.00	7,861.19	138.81
Artists, draftsmen, engravers, etc. .....	35,000	65,000.00	61,159.89	30,657.03	4,342.97
Investigating production of domestic sugar .....	30,000			29,097.27	902.73
Purchase and distribution of valuable seeds .....		5,000.00	4,954.39	4,675.73	324.27
Salaries and expenses, Bureau of Animal Industry .....		130,000.00	114,536.53	112,742.01	17,257.99
Rent of building .....	673,800	675,000.00	661,843.51	659,267.04	14,532.96
Total .....	1,200			1,100.00	100.00
Total .....		1,584,200.00		1,498,241.95	85,958.05
WEATHER BUREAU.					
Salaries, Weather Bureau .....	149,740	150,540.00	150,500.00	148,839.21	900.79
Temporary employment of messengers and laborers .....	800			799.61	.39
Fuel, lights, and repairs, Weather Bureau .....		8,000.00	7,600.00	7,001.46	998.54
Contingent expenses, Weather Bureau .....		8,000.00	7,500.00	7,080.99	919.01
General expenses, salaries .....	352,195	717,162.00	590,525.10	351,192.88	1,002.16
General expenses, miscellaneous .....	364,967			232,178.02	132,788.98
Total, Weather Bureau .....		883,702.00		747,092.13	136,609.87
Grand total .....		2,467,902.00		2,245,334.08	232,567.92

<sup>a</sup> Of this amount, \$720,000 is paid directly to the experiment stations from the Treasury Department.

There was appropriated for 1898, \$14,370 more than for 1897, while the appropriations for 1899 amount to \$288,800 more than for 1898. This increase is shown in the following table, which gives in detail the several appropriations for 1898 and 1899:

*Appropriations for 1898 and 1899.*

Object.	Appropriations for 1898.	Appropriations for 1899.
Salaries, officers, clerks, and employees.....	\$319,300.00	\$319,300.00
Furniture, cases, and repairs, Department of Agriculture.....	9,000.00	9,000.00
Library, Department of Agriculture.....	7,000.00	6,000.00
Museum, Department of Agriculture.....	3,009.00	1,500.00
Postage, Department of Agriculture.....	3,000.00	2,000.00
Contingent expenses, Department of Agriculture.....	25,000.00	25,000.00
Animal quarantine stations.....	12,000.00	12,000.00
Collecting agricultural statistics.....	110,000.00	105,000.00
Botanical investigations and experiments.....	15,000.00	20,000.00
Entomological investigations.....	20,000.00	20,000.00
Vegetable pathological investigations.....	20,000.00	20,000.00
Biological investigations.....	17,500.00	17,500.00
Pomological investigations.....	8,000.00	9,500.00
Laboratory, Department of Agriculture.....	12,400.00	12,400.00
Forestry investigations.....	20,000.00	20,000.00
Experimental gardens and grounds, Department of Agriculture.....	25,000.00	20,000.00
Soil investigations.....	10,000.00	10,000.00
Grass and forage plant investigations.....	10,000.00	10,000.00
Fiber investigations.....	5,000.00	
Irrigation information.....		10,000.00
Agricultural experiment stations.....	a 35,000.00	a 40,000.00
Nutrition investigations.....	15,000.00	15,000.00
Public road inquiries.....	8,000.00	8,000.00
Publications, Farmers' Bulletins.....	\$35,000	
Artists, engravers, distribution, etc.....	30,000	
Purchase and distribution of valuable seeds.....	130,000.00	130,000.00
Investigating production of domestic sugar.....	5,000.00	7,000.00
Salaries and expenses, Bureau of Animal Industry.....	675,000.00	900,000.00
Total.....	1,584,200.00	1,814,200.00
WEATHER BUREAU.		
Salaries, Weather Bureau.....	\$149,740	
Temporary employment of messengers and laborers.....	800	
Fuel, lights, and repairs, Weather Bureau.....	8,000.00	8,000.00
Contingent expenses, Weather Bureau.....	8,000.00	8,000.00
General expenses, salaries.....	\$352,195	
General expenses, miscellaneous.....	364,967	
Meteorological observation stations, West Indies.....		75,000.00
Erection of building at Sault Ste. Marie, Mich.....		3,000.00
Repairs to building and grounds at Bismarck, N. Dak.....		3,000.00
Total, Weather Bureau.....	883,702.00	1,015,502.00
Grand total.....	2,467,902.00	2,829,702.00

a The total appropriations under this head are \$755,000 and \$760,000 for the years given, respectively, but \$720,000 of each appropriation is paid directly to the experiment stations from the Treasury Department. The sums included in the figure columns represent only the amount available for Departmental expenditures.

During the year there were received, audited, and paid 15,576 accounts, including bond-aided and supplemental accounts for the years 1896 and 1897, as follows: Divisional, 4,658, amounting to \$847,621.64; Bureau of Animal Industry, 3,606, amounting to \$733,901.66; Weather Bureau, 7,312, amounting to \$830,437.55. In the settlement of these accounts 25,593 checks were issued from this office, drawn upon the Treasury at Washington and the subtreasuries at New York and Chicago.

The expense for telegraph and telephone service for the Weather Bureau during the year amounted to \$159,357.31.

## REQUISITIONS, LETTERS, AND REQUESTS.

Ninety-nine requisitions were drawn on the United States Treasury for amounts aggregating \$2,451,055.47 in the settlement of all claims against the Department arising during the year and due, including certain supplemental payments.

There were 5,250 requisitions issued during the year for general supplies.

The number of letters of authority issued for traveling and other expenses was 1,011.

There were written and received during the year, in the transaction of the regular business of the division, 31,066 letters.

The number of requests for passenger transportation issued to officers and agents of the Department traveling on official business was 1,645.

There were 1,653 requests drawn on the Quartermaster-General for the transportation of Government property.

## PROCEEDS FROM SALE OF GOVERNMENT PROPERTY.

The following statement includes all sums of money received in this office during the year from the sale of Government property of every description and from whatever source, including card index of the agricultural experiment stations and certain Weather Bureau publications, and from seacoast telegraph lines, amounting to \$8,071.06. These sums were deposited in the Treasury and carried to the proper funds, as the law provides, as follows:

Condemned property .....	\$3,464.61
Card index .....	95.25
Publications .....	91.01
United States seacoast telegraph receipts.....	4,220.19
Total.....	<u>8,071.06</u>

## MONTHLY CHECK STATEMENTS.

The monthly check statements, rendered by the Treasury at Washington and subtreasuries at New York and Chicago during the year, were promptly compared, and certified as agreeing with the records of this office. During the year three checks were lost in the mails or by the persons to whom issued. A duplicate check may be issued at the expiration of six months, by the party in interest complying with certain regulations which are prescribed by the Treasury Department.

## STATEMENT TO CONGRESS OF ANNUAL EXPENDITURES.

In compliance with the law, a detailed report of the expenditures of all appropriations for the fiscal year ending June 30, 1897, including the names of persons employed, and the sums paid to each, was prepared in this office and transmitted through the Speaker of the House, prior to the last session of Congress. These reports of detailed expenditures of the Department are subsequently printed by order of Congress, and may be obtained on application to the House document room.



## UNEXPENDED BALANCES OF APPROPRIATIONS.

The unexpended balances of the appropriations for the year ending June 30, 1896, were carried to the surplus fund and covered into the Treasury on June 30, 1898, as provided by law, amounting to \$488,833.58, or a little less than was estimated in the report of this office for 1896. The balances of the appropriations for 1897 will be returned to the Treasury June 30, 1899, when it appears there will remain slightly less than \$100,000.

## ANNUAL SUPPLIES.

The advertisement soliciting bids for annual supplies to be furnished to this Department during the year 1898 was issued on April 1, 1897, fixing the 5th day of the ensuing month as the date on which all bids then received in response thereto should be opened by the board of awards appointed by the Secretary of Agriculture. After carefully considering and tabulating the bids received, the board duly submitted its recommendations to the Secretary, who approved them, after an explanation by the chairman of the board. These recommendations were then referred to the Treasury for final action in compliance with the act amending section 3709 of the Revised Statutes. The reviewing board of the Treasury approved the recommendations without change, when contracts were awarded by this Department, at rates as satisfactory as those of the preceding year. Each contract, except in cases of insignificant amount, was duly secured by a bond in an equitable sum. All supplies, not included in these contracts, when of an amount to justify the transaction, were obtained on informal or supplementary bids, thus placing nearly all supplies used by the Department under contract, at reduced rates, and saving to the Government a considerable sum of money. Contracts for annual supplies for the year beginning July 1, 1898, have been made at prices ranging practically the same as last year, while samples of certain goods show a marked improvement in quality. The price of ice is 25 cents per 100 pounds, against 30 cents for last year. Fuel is also lower, two items of coal, aggregating 2,500 tons, being 25 cents per ton cheaper. Fewer applications were received for schedules this year than last, and fewer bids were submitted, due apparently to the uncertainties in commercial circles incident to the state of war.

## ESTIMATES OF APPROPRIATIONS.

The estimates of appropriations for the year ending June 30, 1898, were prepared in this division, based on recommendations by chiefs of bureaus, divisions, and offices of the Department. These estimates were, after being approved by the Secretary of Agriculture, promptly transmitted to the United States Treasury. A carefully prepared statement of the various changes in the several items, with accompanying explanations, was furnished to the proper committees of the two Houses of Congress for their information and guidance in considering the recommendations of the Secretary and the needs of the Department. These estimates carried with them a total increase over the appropriations of 1898 of \$367,448, including \$160,348 for the Weather Bureau and \$125,000 for the Bureau of Animal Industry. The appropriations for 1899, as finally passed by Congress, amounted

to \$288,800 more than for 1898, or \$78,640 less than was estimated by the Department.

The largest increase in any of the appropriations of the Department for 1899 appears in that for the Bureau of Animal Industry. This appropriation was increased in the Department estimates from \$675,000 to \$800,000, and was further increased by Congress to \$900,000 to provide for the greatly increased demand for microscopically inspected meats, and to further continue and extend hog-cholera and swine-plague investigations.

In addition to the above there was included under "Salaries and expenses, Bureau of Animal Industry," in the appropriations for the current year a special appropriation of \$37,500 for printing 75,000 copies of the work known as the "Special report on the diseases of the horse." It is further provided that 25,000 copies shall be for the use of the Senate and 50,000 for the use of the House. It is difficult to account for the inclusion in the appropriations for the Department of Agriculture of any sum devoted to a specific purpose not included in the objects of the Department. It is usual when publications of the Department are printed by order of Congress to not only defray the cost thereof from a special appropriation not chargeable to the Department, but to make provisions for a certain number of copies to be placed at the disposal of the Secretary. In this case not only is the entire cost of the publication in question included in the appropriations for this Department, but not a single copy of the book can be disposed of by the Secretary, and the expenditure of this appropriation for the purpose intended is entirely controlled by the Public Printer, an officer not connected with the Department and in no way responsible to the Secretary. The impropriety of an appropriation involving the addition of a large sum to the Department appropriations for a purpose in no way connected with the service of the Department, and the expenditure for which is in no way controlled or supervised by the head of the Department, is obvious.

Two similar instances occurred in the appropriation bill for 1897, and then, as now, the "Special report on the diseases of the horse" was one of the objects provided for. There is no other case known to me on record in which appropriations for extraneous service have been included in the Department appropriations, and being a new departure, and one that is manifestly objectionable, this would seem to be a proper time to enter a protest against such a course.

For the fiscal year 1898 the appropriations for the employment of "Messengers, laborers, mechanics, watchmen, and charwomen," and for "Furniture, cases, and repairs," were reduced by \$1,000 each by the Committee on Agriculture, apparently through misapprehension. The great inadvisability of this reduction has been clearly manifest throughout the Department during the past year, as the demands on these two funds are increasing annually with the natural growth of the Department. It is therefore imperative that, in order to meet this demand, the appropriations named be increased to the amounts originally carried by them; and it is earnestly hoped that the estimates for the ensuing year will provide for this increase.

The fund for "Fiber investigations," which has been continued annually for a series of years, was omitted from the appropriations for 1899 by Congress, although provided for in the estimates of the Department for that year. An appropriation of \$10,000 for "Irrigation information, 1899," was added by Congress, and the fund for "Investigating production of domestic sugar" was increased by \$2,000.

The appropriation act also provides a special fund for the erection of a building on the Government reservation at Sault Ste. Marie, Mich., at an expense of \$3,000, for the use of the Weather Bureau.

The sundry civil bill approved July 1, 1898, appropriates \$3,000, to be expended under the direction of the Secretary of Agriculture, for necessary repairs to buildings and grounds at Bismarck, N. Dak.

In accordance with the provisions of the law making an appropriation for the "Purchase and distribution of valuable seeds," etc., bids were invited early in October, 1897, for furnishing seeds to the Department for the year 1898. In response to this advertisement, proposals were submitted to the Department by twenty-four reputable seed firms, representing the several sections of the United States, in amounts ranging from \$143,983.48 to \$69,420.28, on precisely the same schedule, which had been prepared and sent out by the Department. These bids were all submitted to a board duly appointed by the Secretary of Agriculture. An award was made to the Henry Philipps Seed and Implement Company, of Toledo, Ohio, the lowest bidder. A contract was prepared in this office, dated October 30, 1897, and was duly executed by the Philipps Company. A supplemental contract was made with the same firm on similar terms and conditions, dated January 15, 1898, for \$15,419.21, making a total of \$84,839.49, leaving a balance of \$25,160.51 of the entire amount appropriated for seed to be expended in the open market on the direct order of the Secretary, as provided for in the appropriation act. Both contracts were secured by a bond in amount amply sufficient to protect the Department, while it was provided that 10 per cent of the total amount should be reserved until all provisions of the contracts had been fully complied with by the party receiving the award.

#### NEW TELEPHONE SYSTEM.

After a preliminary correspondence a contract was closed with the Chesapeake and Potomac Telephone Company on June 22, 1898, providing for the installation and maintenance of a new and thoroughly improved system, comprised of thirteen stations, directly connecting the several branches of the Department, and, through the central telephone exchange, establishing perfect communication, not only with all sections of the city, but with New York, Chicago, and other points reached by the most approved long-distance service. Additional stations may be added at a fixed and reasonable rate. This new system, it is believed, will prove of great practical advantage, facilitating and expediting the constantly increasing business relations of the Department.

#### REVISED FINANCIAL REGULATIONS.

By the direction of the Secretary of Agriculture, the chief of the Division of Accounts and Disbursements prepared certain regulations governing financial transactions with this Department, which went into effect July 1, 1894. Four years' experience has shown that these regulations have been of marked advantage to the Department from an economic and business standpoint, establishing and enforcing methods fully in line with the requirements of the Treasury Department and making it possible to keep within the statutes relating to the handling of official accounts and the disbursement of public funds. Since the date of publication of these regulations certain rulings and opinions by the Comptroller of the Treasury and the



Attorney-General and new and amended laws affecting the financial interests of the Government have rendered certain changes necessary in the regulations of the above date. In response to this need, the acting law clerk of the Department, under the supervision of the chief of this division, was directed to revise these regulations. A careful revision was accordingly made, going into effect July 1, 1898, under the title of "Fiscal regulations of the United States Department of Agriculture," superseding all prior rules and regulations affecting financial transactions with said Department. Only such changes were made as were essential in complying with amended laws and recent rulings and to effect an improved arrangement of subjects. All officers and employees of the Department in any way affected by these regulations have been supplied with copies of the revised edition.

#### ASSIGNMENT OF LAW CLERK.

In the report of the chief of this division for 1897 the urgent need for the services of a "law clerk" was indicated and the appointment or assignment of such an officer strongly recommended. On February 8, 1898, Mr. W. C. Pennywitt, a third-class clerk in this division, was assigned to duty as law clerk, under the superintendency of the chief of the Division of Accounts and Disbursements. This assignment will fill a long-felt need in the official economy of the Department and, it is believed, prove very satisfactory.

#### METHOD OF PUBLIC ADVERTISING.

In response to a letter from the Secretary of the Treasury, dated April 21, 1897, addressed to the Secretary of Agriculture, requesting to be "furnished with the name of a competent person" to represent this Department at a conference proposed to be held in the office of the Secretary of the Treasury for the purpose of devising a uniform method in the matter of public advertising and the settlement of accounts connected therewith, you were pleased to designate the chief of this division. Similar letters were addressed to the heads of all the Executive Departments of the Government, resulting in the organization of a full committee, with the Chief Clerk of the Treasury Department as permanent chairman. A final report was made to the Secretary of the Treasury February 25, 1898. As a result of the inquiries and labors of the committee a decided change was effected in the method of advertising and the several forms used in connection therewith, while a clear and comprehensive understanding of the laws on the subject and the adoption of a uniform method throughout by all the Departments was reached. These changes are far-reaching in their importance, establishing in the several Departments uniformity, accuracy, a permanent and detailed record, as well as securing an enormous saving of money to the Government.

In addition to the subject of public advertising, that of the official "Transportation request," issued for transporting Government officials over bond-aided and other railroads in the United States, was considered and acted on by the committee. After careful inquiry and comparison of forms then in use, a style of "request" was decided on and adopted which, it is believed, will meet the needs of the several Departments and greatly simplify and facilitate this feature of the public service. The passenger transportation request is now in general



use by the employees of the Government traveling on official business, and is readily accepted by all railroad and steamboat companies in the United States and by the trans-Atlantic steamship companies, thus proving a great accommodation to those who may have occasion to travel for the Government.

#### BUILDINGS RENTED BY THE DEPARTMENT.

*In the District of Columbia.*—The following is a statement of the location, annual rental, and use of the various buildings under lease by this Department in the District of Columbia during the year 1898:

No. 1362 B street SW., Bureau of Animal Industry laboratory .....	\$1,200
No. 1364 B street SW., chemical laboratory .....	900
No. 212 Thirteenth street SW., offices and laboratories .....	660
No. 214 Thirteenth street SW., offices and laboratories .....	660
Total .....	3,420

*Outside of the District of Columbia.*—The Bureau of Animal Industry Veterinary Experiment Station, for some years past located at Bennings, D. C., was transferred last fall to Oatland, near Bethesda, Montgomery County, Md., lease dated August 1, 1897, for period of five years.

The following are the Bureau of Animal Industry and Weather Bureau stations under lease by the Department of Agriculture outside of the District of Columbia for the year 1898:

#### BUREAU OF ANIMAL INDUSTRY.

##### *Stations, with location and annual or monthly rental.*

Station.	Location.	Rent.
Baltimore, Md. ....	No. 215 St. Paul street .....	\$125 per annum.
Bethesda, Md. ....	Montgomery County .....	\$50 per month.
Boston, Mass. ....	No. 21 Doane street .....	\$40 per month.
Buffalo, N. Y. ....	East Buffalo Live Stock Exchange Building .....	\$30 per month.
Chicago, Ill. ....	No. 4193 South Halsted street .....	\$300 per month.
Do .....	Exchange Building, Union Stock Yards .....	\$15 per month.
Garfield, N. J. ....	(Quarantine station) .....	\$1,800 per annum.
Indianapolis, Ind. ....	Kingan & Co.'s abattoir .....	\$10 per month.
Kansas City, Kans. ....	No. 74 South James street .....	\$45 per month.
Do .....	Live Stock Exchange Building .....	\$25 per month.
Littleton, Mass. ....	(Quarantine station) .....	\$250 per annum.
National Stock Yards, Illinois. ....	St. Clair County .....	\$75 per month.
New York, N. Y. ....	No. 18 Broadway .....	\$500 per annum.
Do .....	No. 109 West Forty-second street .....	\$40 per month.
Norfolk, Va. ....	No. 70 Plume street .....	\$12 per month.
San Francisco, Cal. ....	87 Flood Building .....	\$20 per month.
South Omaha, Nebr. ....	Over Packers' National Bank .....	\$55 per month.
South St. Joseph, Mo. ....	Buchanan County .....	\$180 per annum.
St. Denis, Md. ....	Maryland .....	\$225 per annum.

## WEATHER BUREAU.

*Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.*

No.	Station.	Location.	Rent.	
			Amount.	Includes—
1	Abilene, Tex.	On South 1st street.	\$424.45	Heat, cleaner, oil, matches, ink, mucilage, brooms, ice, and water.
2	Albany, N. Y.	In public building, corner Broadway and State street.		
3	Alpena, Mich.	Corner Fletcher and Dock streets.	*211.36	Heat, cleaner, light, oil, matches, ink, and mucilage.
4	Amarillo, Tex.	Corner Polk and 5th streets.	*290.00	Heat, cleaner, oil, matches, and ice.
5	Astoria, Oreg.	In Western Union Building, corner 11th and Commercial streets.	*180.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, and ice.
6	Atlanta, Ga.	In public building, corner Marietta and Forsyth streets.		
7	Atlantic City, N. J.	In Real Estate and Law Building, 1421 Atlantic avenue.	*137.00	Heat and light.
8	Augusta, Ga.	In public building, corner Campbell and Greene streets.		
9	Baker City, Oreg.	In Bloch Building, on Main street.	*310.00	Heat, cleaner, light (oil), matches, ink, mucilage, brooms, ice, and soap.
10	Baltimore, Md.	Johns Hopkins University, 532 North Howard street.		
11	Binghamton, N. Y.	In public building, corner Water and Henry streets.		
12	Birmingham, Ala.	In Walker & Jordan Building, 2011 1st avenue.	60.00	
13	Bismarck, N. Dak.	In public building, corner Main and 1st streets.		
14	Block Island, R. I.	In Weather Bureau building, on Main street.	*259.97	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, and ice.
15	Boston, Mass.	In public building, Post-Office square.		
16	Buffalo, N. Y.	In Prudential Building, corner Pearl and Church streets.	*504.76	Do.
17	Cairo, Ill.	In public building, corner Washington avenue and 14th street.		
18	Canby, Fort, Wash.	In Weather Bureau building, summit of Cape Hancock.		
19	Cape Henry, Va.	In Ocean House, corner Decatur street and Beach avenue.	*340.00	Heat, cleaner, and light.
20	Cape May, N. J.	In public building, on Carson street.		
21	Carson City, Nev.	In public building, 200 East Bay street.		
22	Charleston, S. C.	In public building, corner Trade and Mint streets.		
23	Charlotte, N. C.	In public building, corner 11th and A streets.		
24	Chattanooga, Tenn.	In Commercial Building, 216-218 West 16th street.	*367.61	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, and soap.
25	Cheyenne, Wyo.	Auditorium Building, corner Walsh avenue and Congress street.	*1,800.00	Heat, cleaner, light, oil, matches, ink, mucilage, ice, water, soap, and elevator.
26	Chicago, Ill.	In public building, 5th street between Walnut and Main streets.		
27	Cincinnati, Ohio.	In Society for Savings Building, on the Park.		
28	Cleveland, Ohio.		*1,140.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, toilet supplies, power for electric motor, and storeroom.
29	Columbia, Mo.	In Agricultural College building, Campus State University.		
30	Columbia, S. C.	In public building, corner Main and Laurel streets.		

31	Columbus, Ohio	In Eberly Block, 203-215 South High street	* 616.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, washing towels and flags, rent of telephone, gas for stereotyping, electric power for press, and district messenger service.
32	Concordia, Kans	Post-office building, on 6th street	* 220.00	Heat, cleaner, light, matches, and ice.
33	Corpus Christi, Tex	French's store, corner Chaparral and Star streets	* 296.80	Heat, cleaner, light (oil), matches, ink, mucilage, brooms, and ice.
34	Davenport, Iowa	In public building, corner 4th and Perry streets		
35	Denver, Colo	In public building, corner 16th and Arapahoe streets		
36	Des Moines, Iowa	In public building, corner 5th street and Court avenue		
37	Detroit, Mich	Union Trust Building, corner Griswold and Congress streets	* 550.00	Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
38	Dodge City, Kans	Beeson Block, on Front street		
39	Dubuque, Iowa	Bank and Insurance Building, corner Main and 9th streets	* 389.65	Heat, cleaner, electric light and power, oil, matches, ink, mucilage, brooms, ice, water, soap, and elevator.
40	Duluth, Minn	In public building, 1st street and 5th avenue, west		
41	East Clallam, Wash	Telegraph office, Frontier street	* 400.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, soap, brushes, stove polish, and lavatory.
42	Eastport, Me	In public building, corner Water and Washington streets		
43	El Paso, Tex	In public building, St. Louis and Oregon streets		
44	Erie, Pa	In public building, Park Row and State streets		
45	Eureka, Cal	In Buhne's brick building, corner 2d and G streets	* 334.65	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, and water.
46	Evansville, Ind	In Federal Building, 2d street between Vine and Sycamore streets		
47	Fort Smith, Ark	Hotel Main, Nos. 606 and 608 Garrison avenue	* 240.00	Heat, cleaner, light, land oil, matches, ink, mucilage, brooms, ice, water, soap, mops, brushes, dusters, and cleaning river gauge.
48	Fresno, Cal	Farmers' Bank of Fresno Building	* 490.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, mops, and telephone service.
49	Galveston, Tex	Levy Building, corner 23d and Market streets	* 600.00	Heat, cleaner, light, water, elevator, brooms, ice, and soap.
50	Grand Haven, Mich	Cutler House, corner 3d and Washington streets	* 237.29	Heat, cleaner, light, oil, matches, ink, mucilage, and brooms.
51	Green Bay, Wis	Parmentier Block, 324-328 Washington street	* 300.00	Heat, cleaner, light, matches, ink, mucilage, brooms, and soap.
52	Hannibal, Mo	In public building, corner Broadway and 6th street		
53	Harrisburg, Pa	In public building, corner 3d and Walnut streets		
54	Hatteras, N. C	In Styron's House, main road	* 154.30	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, and soap.
55	Hayre, Mont	In Gussenhoven Building, 1st street between 3d and 4th avenues	* 180.00	Heat, cleaner, light, matches, brooms, ice, and water.
56	Helena, Mont	In Power Block, corner Main street and 6th avenue		
57	Huron, S. Dak	Jeffris Block, 337 Dakota avenue	* 420.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
58	Idaho Falls, Idaho	In Graehl Hotel, corner Front and Shoup streets	* 400.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, soap, and water closet.
59	Independence, Cal	In Norman House, corner Market and Edward streets	* 360.00	Heat, cleaner, light, matches, brooms, ice, water, and soap.
60	Indianapolis, Ind	In Majestic Building, 43 South Pennsylvania street	* 270.00	Heat, cleaner, light, matches, and soap.
61	Ithaca, N. Y	In Lincoln Hall, Cornell University	* 1,000.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and water.

\* In accordance with existing lease.



*Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.—Continued.*

No.	Station.	Location.	Rent.	
			Amount.	Includes—
62	Jacksonville, Fla.	In Astor Building, 138 West Bay street.	\$ 800.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, telephone service, and electric light for signals.
63	Jupiter, Fla.	In Weather Bureau building, near lighthouse		
64	Kansas City, Mo.	In Radio building, corner Grand avenue and 9th street.	\$ 600.00	Heat, cleaner, light, brooms, ice, and water.
65	Kookuk, Iowa.	In public building, corner Seventh and Blendeau streets		
66	Key West, Fla.	In Waite Building, corner Duval and Wall streets	\$ 475.30	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and water.
67	Kittylhawk, N. C.	In Weather Bureau building, on the beach.		
68	Knoxville, Tenn.	University of Tennessee		
69	Knoxville, Wis.	In public building, corner 4th and State streets.		
70	La Crosse, Wis.	In Bancroft & Linn's Block, Main street.	\$ 350.00	Heat, cleaner, light, matches, brooms, and ice.
71	Lander, Wyo.	In Federal Building, corner Michigan and Capitol avenues		
72	Lansing, Mich.	In University of Nebraska Building, corner 12th and T streets		
73	Lincoln, Neb.	In Miller Building, 202 East Markham street	\$ 121.20	Heat, cleaner, oil, matches, ink, mucilage, and ice.
74	Little Rock, Ark.	Wilson Building, 102½ South Spring street	\$ 553.30	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and water.
75	Louisville, Ky.	In public building, corner 4th and Chestnut streets	\$ 270.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, and soap.
76	Lynchburg, Va.	Law Building, 805-809 Main street		
77	Marquette, Mich.	In public building, corner 3d and Washington streets		
78	Memphis, Tenn.	In Continental National Bank, corner Main and South Court streets.	\$ 600.00	Heat, cleaner, light, water, and elevator.
79	Miles City, Mont.	In Bryan & Larsen Building, corner 7th and Main streets	\$ 168.00	Heat, light, oil, matches, ink, mucilage, and brooms.
80	Milwaukee, Wis.	In Mitchell Building, corner Michigan and East Water streets.	655.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, soap, elevator, and flagstaff.
81	Minneapolis, Minn.	In public building, corner 3d street and 1st avenue, south		
82	Mobile, Ala.	In public building, corner St. Francis and Royal streets		
83	Montgomery, Ala.	In public building, corner Lawrence street and Dexter avenue.		
84	Moorhead, Minn.	In First National Bank, corner Front and 6th streets.	\$ 255.25	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, and soap.
85	Mount Washington, N. H.	On summit	\$ 5.00	Heat, light, ink, mucilage, brooms, ice, water, and electric light for signals.
86	Nantucket, Mass.	In Pacific Clubhouse, corner Main and Water streets.	\$ 270.00	Heat, light, matches, ink, mucilage, and brooms.
87	Narragansett Pier, R. I.	In Odlen Cottage, Kingstown street	\$ 150.96	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
88	Nashville, Tenn.	In Chamber of Commerce, No. 307 Church street.	300.00	
89	Neah Bay, Wash.	In Indian agency building, facing bay		
90	New Brunswick, N. J.	In New Jersey Experiment Station building, corner Bleeker Place and Hamilton street.		
91	New Haven, Conn.	In Insurance Building, No. 890 Chapel street	\$ 400.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, water, and soap.
92	New Orleans, La.	In public building, corner Decatur and Custom-House streets		
93	New York, N. Y.	In Manhattan Building, 66 Broadway		



94	Norfolk, Va.	In Dodson Building, 53 Main street	*525.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and water.
95	Northfield, Vt.	In Norwich University, on Central street	---	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, and soap.
96	North Platte, Nebr.	In Odd Fellows' Hall, corner 5th and Spruce streets	*33.50	Heat, cleaner, light, ink, mucilage, brooms, ice, and water.
97	Oklahoma, Okla.	In Opera House Block, corner Robinson street and Grand avenue	*510.00	Heat, cleaner, light, and elevator.
98	Omaha, Nebr.	In McCague Building, corner Dodge and 15th streets	*500.00	Heat, cleaner, light, and elevator.
99	Oswego, N. Y.	In public building, Oneida street	---	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, and soap.
100	Palatine, Tex.	In Colley-Wright Building, 1-5 Sycamore street	*314.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, and soap.
101	Parkersburg, W. Va.	In public building, corner 5th and Juliana streets	---	Do.
102	Pensacola, Fla.	In public building, corner Palafox and Government streets	---	Heat, light, ink, mucilage, brooms, lead pencils, pens, penholders, and dustpans.
103	Philadelphia, Pa.	In public building, corner 9th and Chestnut streets	*210.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
104	Phoenix, Ariz.	In Wharton Building, on Center street	---	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, soap, and flagstaff.
105	Pierre, S. Dak.	In National Bank of Commerce, corner Dakota avenue and Court street	*370.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
106	Pittsburg, Pa.	In public building, Smithfield street, 3d to 4th avenues	---	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
107	Poin Reyes Light, Cal.	In Light House building	---	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, soap, and flagstaff.
108	Port Angeles, Wash.	In Opera House Block, Front street	*180.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
109	Port Crescent, Wash.	In Hart's Building, corner 3d and A streets	*60.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
110	Port Huron, Mich.	In Federal building, corner 6th and Water streets	*504.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, soap, and flagstaff.
111	Portland, Me.	First National Bank, 37 Exchange street	---	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
112	Portland, Ore.	In Oregonian Building, corner 6th and Alder streets	---	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
113	Pueblo, Colo.	In Swift Block, corner 6th and Main streets	*300.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
114	Pysht, Wash.	In Merrill, Bliss & Co.'s building	*100.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, soap, brushes, dusters, and towels.
115	Raleigh, N. C.	In Fisher Building, corner Fayetteville street and Exchange place	*240.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
116	Rapid City, S. Dak.	In Lakota Building, corner 7th and St. Joe streets	*276.00	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, soap, brushes, dusters, and towels.
117	Red Bluff, Cal.	In Cone & Kimball Building, corner Main and Walnut streets	*336.25	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, and soap.
118	Richmond, Va.	In Chamber of Commerce Building, corner 9th and Main streets	*580.00	Heat, cleaner, light, water, elevator, electric power for press, and gas for stereotyping furnace.
119	Rochester, N. Y.	In public building, corner Church and Fitzhugh streets	---	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, soap, and chimneys.
120	Roseburg, Ore.	In Marks Building, 228½ Jackson street	*300.00	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, soap, and chimneys.
121	Sacramento, Cal.	In public building, corner 7th and K streets	*300.85	Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, soap, and chimneys.
122	St. Louis, Mo.	In public building, on Olive street, between 8th and 9th	*400.00	Heat, cleaner, light, matches, and brooms.
123	St. Paul, Minn.	In Chamber of Commerce Building, 112 East 6th street	*192.00	Heat, cleaner, light, and water.
124	Salt Lake City, Utah	In Board of Trade Building, 154 West 2d South street	---	Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
125	San Antonio, Tex.	In Maverick Bank Building, corner Houston street, Alamo Plaza	*360.00	Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
126	San Diego, Cal.	In Keating Building, corner 5th and F streets	---	Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
127	Sandusky, Ohio.	In public building, corner Columbus avenue and Market street	---	Heat, cleaner, light, matches, ink, mucilage, brooms, ice, soap, and chimneys.

\* In accordance with existing lease.

*Stations, with location and annual rental, including such items as heat, light, janitor, ice, brooms, matches, etc.—Continued.*

No	Station.	Location.	Amount.	Rent.	Includes—
128	San Francisco, Cal	In Mills Building, corner Bush and Montgomery streets	\$1,290.00		Heat, cleaner, light, water, electric power for printing press, and gas for stereotyping.
129	San Luis Obispo, Cal	In Rackliffe Building, corner Choro and Marsh streets	*300.00		Heat, cleaner, light, oil, matches, ink, mucilage, brooms, ice, water, and soap.
130	Santa Fe, N. Mex	In Catron Building, corner Plaza on Palace avenue	*420.00		Heat, light, and water.
131	Sault Ste. Marie, Mich	In News Building, 33 Ashmun street	*336.00		Heat, cleaner, light, matches, ink, mucilage, brooms, and soap.
132	Savannah, Ga	In Board of Trade Building, 103 Bay street	*325.00		Heat, cleaner, light, and water.
133	Seattle, Wash	In New York Building, corner Cherry and 2d streets	*480.00		Do.
134	Shreveport, La	In public building, corner Texas and Marshall streets			Heat, cleaner, light, matches, ink, mucilage, and ice.
135	St. Louis, Mo	In public building, corner 6th and Douglas streets			Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
136	Spokane, Wash	In Jamieson Building, 705 Riverside avenue	*180.00		Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
137	Springfield, Ill	In public building, corner Monroe and 6th streets			Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
138	Springfield, Mo	In Chamber of Commerce Building, corner C and 9th streets			Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
139	Tacoma, Wash	In Knight Building, No. 315, Franklin street	*240.00		Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
140	Tampa, Fla	In Weather Bureau Building, northeast corner island	*317.75		Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
141	Tatoosh Island, Wash	In Columbian Building, corner Madison and St. Clair streets			Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
142	Toledo, Ohio	In public building, corner 6th and Douglas streets			Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
143	Topeka, Kans	Corner Main and Catharine streets	*350.00		Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
144	Valentine, Neb	In public building, corner Crawford and Walnut streets	*300.00		Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
145	Vicksburg, Miss	In Eagleson Block, west side Main street	*290.00		Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
146	Vineyard Haven, Mass	In Pine Brothers' building, corner Main and 2d streets			Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
147	Walla Walla, Wash	In U. S. Life-Saving Station Building	*295.80		Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
148	Wash. Woods, N. C	In The Sedgwick, corner 1st and Market streets	*330.00		Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
149	Wichita, Kans	Corner Main and Broadway	*300.00		Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
150	Williston, N. Dak	In public building, corner Front and Chestnut streets			Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
151	Winnington, N. C	In county court-house, on Bridge street	*248.00		Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
152	Winnemucca, Nev	In Fish Commission Building, on Main street			Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
153	Woods Hole, Mass	In Union Block, corner 3d and Walnut streets	*280.00		Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
154	Yankton, S. Dak	In public building, on Government reservation			Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
155	Yuma, Ariz	In U. S. Life-Saving Station Building			Heat, cleaner, light, matches, ink, mucilage, brooms, and ice.
	Total		34,191.20		

\* In accordance with existing lease.

## SETTLEMENT OF ACCOUNTS.

All accounts of the Department paid during the year ending June 30, 1898, were promptly forwarded to the United States Treasury for settlement at the close of each quarter. Those for the first three quarters of the year have been passed by the accounting officers and certified as correct. The accounts for the fourth quarter are now in course of settlement by the Auditor. The supplemental accounts included in this quarter have already been stated. There are no suspensions or disallowances at this time, nor was any deficiency created in any of the appropriations during the year. This record is gratifying in view of the many thousands of accounts audited and paid in this office during the year, especially when it is remembered that a large percentage of them are of an exceedingly intricate and technical character. It is further gratifying to report that the work of the Division of Accounts and Disbursements is fully up at this date, clearly attesting the industry and high state of efficiency of the employees of the division.

## THE ACCOUNTS OF THE FISCAL YEAR 1896 FINALLY CLOSED.

The accounts for the fiscal year ending June 30, 1896, were finally closed and the balance of the appropriations carried to the surplus fund June 30, 1898. The following statement of the appropriations, disbursements, and unexpended balances for that year is appended, and is a continuation of the detailed statement submitted in the report of this division for 1895:

*Appropriations, disbursements, and amount unexpended for the year 1896.*

Object.	Appropriations, 1896.	Total appropriations.	Amount of warrants.	Amount disbursed.	Amount unexpended.
Salaries, officers and clerks.....	\$222,840	\$252,846.00	\$219,000.00	\$188,991.76	\$33,848.24
Messengers, laborers, mechanics, etc.....	20,000			19,538.05	461.95
Additional assistants in laboratory.....	10,000			8,537.16	1,462.84
Collecting agricultural statistics.....	100,000			63,800.59	36,199.41
Investigating foreign demands for United States agricultural products.....	10,000	110,000.00	68,846.56	4,828.40	5,171.60
Inquiries relating to public roads.....		10,000.00	9,638.60	9,568.39	431.61
Botanical investigations and experiments.....		25,000.00	20,458.75	20,325.37	4,674.63
Investigating the history and habits of insects.....		20,000.00	17,448.60	17,372.43	2,627.57
Investigations in ornithology and mammalogy.....		17,500.00	16,341.00	16,175.45	1,324.55
Pomological information.....		6,000.00	5,102.35	4,996.41	1,003.59
Microscopical investigations.....		2,000.00			2,000.00
Vegetable pathological investigations and experiments.....		20,000.00	18,598.26	18,539.18	1,460.82
Laboratory, Department of Agriculture.....	4,000	14,900.00	11,597.72	3,051.84	948.16
Rent, laboratory buildings.....	900			900.00	
Investigation of soils.....	5,000			4,930.05	69.95
Adulteration of food.....	5,000			2,576.64	2,423.36
Report on forestry.....		25,000.00	18,398.12	18,398.12	6,601.88
Illustrations and engravings.....		15,000.00	13,300.00	12,985.71	2,014.29
Document and folding room.....		2,000.00	1,300.00	1,061.23	938.77
Experimental gardens and grounds.....		29,500.00	22,400.00	22,371.15	7,128.85
Quarantine stations for neat cattle.....		12,000.00	6,608.66	6,492.05	5,507.95
Purchase and distribution of valuable seeds.....	130,000	185,400.00	123,735.23	84,707.05	45,292.95
Farmers' Bulletins.....	50,000			39,558.94	10,441.06
Printing.....	5,400			2,210.88	3,189.12
Experiments in the manufacture of sugar.....	9,750			1,448.44	8,301.56
Additional temporary compensation to chemist.....	250	10,000.00	1,570.00	62.50	187.50



*Appropriations, disbursements, and amount unexpended, etc.—Continued.*

Object.	Appropriations, 1896.	Total appropriations.	Amount of warrants.	Amount disbursed.	Amount unexpended.
Agricultural experiment stations..	<i>a</i> \$750,000	\$30,000.00	\$27,712.86	\$27,712.86	\$2,287.14
Irrigation investigations.....		15,000.00	5,029.82	5,029.82	9,970.18
Nutrition investigations.....		15,000.00	14,900.00	14,892.96	107.04
Investigations and experiments with grasses and forage plants.....		15,000.00	13,376.24	13,329.47	1,670.53
Investigations in relation to agricultural soils.....	13,400	15,000.00	13,524.84	12,204.84	1,195.16
Rent.....	1,600				
Furniture, cases, and repairs.....		10,000.00	9,032.90	8,645.98	1,354.02
Postage.....		2,000.00	1,350.00	1,215.00	785.00
Museum.....		3,000.00	2,201.90	2,161.90	838.10
Fiber investigations.....		5,000.00	3,800.00	3,710.36	1,289.64
Library.....		6,000.00	5,597.34	5,431.92	568.08
Contingent expenses.....		25,000.00	16,006.32	15,912.71	9,087.29
Salaries and expenses, Bureau of Animal Industry.....	797,800	800,000.00	595,428.68	593,136.64	204,663.36
Rent of laboratory.....	1,200			1,200.00	-----
Additional temporary compensation to chief of bureau.....	1,000			1,000.00	-----
Total.....		1,698,140.00	-----	1,280,332.25	417,807.75
WEATHER BUREAU.					
Salaries.....	163,490	164,290.00	144,500.00	142,038.01	21,451.99
Temporary employment of messengers and laborers.....	800				
Fuel, lights, and repairs.....		8,000.00	6,900.00	360.00	440.00
Contingent expenses.....		10,000.00	5,216.43	6,220.63	1,779.37
General expenses, salaries.....	347,195	703,320.00	661,203.09	4,982.99	5,017.01
General expenses, miscellaneous.....	356,125			341,576.70	5,618.30
Total, Weather Bureau.....		885,610.00	-----	319,405.84	36,719.16
Grand total.....		2,583,750.00	-----	814,584.17	71,025.83
			-----	2,094,916.42	488,833.58

*a* Of this amount, \$720,000 is paid directly to the experiment stations from the Treasury Department.

## OFFICIAL APPROVAL OF MANAGEMENT OF OFFICE.

By direction of the Auditor for the State and other Departments, an expert examination and inspection of the books, papers, cash on hand, and other matters relating to the accounts of this office was made under authority of the act of February 19, 1897, during last September, resulting in the following letter:

TREASURY DEPARTMENT,  
OFFICE OF AUDITOR FOR THE STATE AND OTHER DEPARTMENTS,  
Washington, D. C., October 7, 1897.

*The Honorable the Secretary of Agriculture:*

SIR: I have the honor to inform you that, acting under the authority given me by the act of February 19, 1897, I have caused an examination to be made of the books, papers, and accounts of F. L. Evans, Disbursing Clerk of the Department of Agriculture.

It affords me great pleasure to inform you that I have found his accounts neatly and correctly kept, and that all public funds which have been received by him were found to be in his hands, or properly accounted for.

Respectfully, yours,  
(Signed)

ERNST G. TIMME, *Auditor.*



## REPORT OF THE DIRECTOR OF THE OFFICE OF EXPERIMENT STATIONS.

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF EXPERIMENT STATIONS,  
*Washington, D. C., September 10, 1897.*

SIR: I have the honor to present herewith the report of the Office of Experiment Stations for the fiscal year ending June 30, 1898.

Respectfully,

A. C. TRUE,  
*Director.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

#### SUPERVISION OF EXPENDITURES OF EXPERIMENT STATIONS.

The third annual examination of the work and expenditures of the agricultural experiment stations which receive the national funds appropriated under the act of Congress of March 2, 1887 (Hatch Act), with special reference to the fiscal year ended June 30, 1897, was made during the past year in accordance with the authority conferred upon the Secretary of Agriculture by Congress, and a report of this investigation was prepared for transmission to Congress, as required by law. This report was published as House of Representatives Document No. 205 (Fifty-fifth Congress, second session), and the special edition ordered by Congress for the use of this Department was issued as Bulletin No. 50 of the Office of Experiment Stations and distributed to the governing boards and officers of the stations. The nature and extent of the work of this office in connection with the supervision of the expenditures of the stations, as well as the general character and scope of the report on their work and expenditures, are indicated by the following statements taken from the report:

As heretofore, the report is based on three sources of information, viz: The annual financial statements of the stations, rendered on the schedules prescribed by the Secretary of Agriculture, in accordance with the act of Congress; the printed reports and bulletins of the stations; and the reports of personal examinations of the work and expenditures of the stations made during the past year by the Director and Assistant Director of the Office of Experiment Stations. All the stations, except those in Alabama, Mississippi, Louisiana, and Texas, were visited since the previous report was transmitted to Congress. \* \* \*

#### THE FINANCIAL BUSINESS OF THE STATIONS.

From the point of view of this Department, representing the interests of the United States, the financial business of the stations is in better condition than ever before. The account of the Hatch fund is now, as a rule, kept distinct from that of other funds controlled by the station or the college of which the station is a department. The purposes for which the Hatch fund may be properly expended

are more clearly defined, and the adjustment of expenditures as between the station and the other departments of the college has been more exactly made. Experience has clearly demonstrated that it is essential that a current account of the Hatch fund, which shall be distinct and separate from all other accounts, shall be kept, preferably in accordance with a form recommended by this Department, and that this account shall be supported by a numbered series of detailed vouchers, each complete in itself as regards statement of the account, signature of the payee, and indorsement of the director or other executive officer of the station, who is made responsible by the governing board for the expenditure of the fund for the purposes denominated in the Hatch Act. Owing to the complicated financial business of many of the institutions receiving the benefits of this act, it has been a matter of considerable difficulty to arrange the details of the accounting in a manner thoroughly satisfactory to all concerned. It is believed, however, that the expenditures on account of the Hatch fund are now recorded with substantial accuracy. The problems respecting the proper expenditure of this fund now relate almost entirely to questions of general policy, some of which will be briefly considered in this report.

#### THE SUBSTATIONS.

Considerable progress has been made during the past year in securing the reduction of expenditures from the Hatch fund on substations. In Idaho, Washington, Kansas, and Florida the substations have been entirely discontinued; in Wyoming, Colorado, New Mexico, Arizona, and Arkansas, the number of substations has been diminished, expenditures for permanent improvements have ceased, and other expenditures have been reduced. In this way a considerable portion of the Hatch fund hitherto largely thrown away or extravagantly expended on trivial experiments will hereafter be available for more thorough investigations under the immediate direction of the expert officers of the stations. Substations are maintained, as formerly, in California, Minnesota, and Texas, but in these States the experiment stations have at their command resources derived from the State to supplement the Hatch fund. In Connecticut, New York, and Alabama two separate stations are maintained with the aid of State funds, and in a similar way three stations are maintained in Louisiana.

#### FARM AND DAIRY OPERATIONS.

At a number of the stations farm and dairy operations are still conducted on too extensive a scale and with too little appreciation of the real requirements of experimental inquiries in agriculture. In this way a large amount of money is rapidly expended, the time and energies of the station officers are largely employed in routine duties, numerous petty and superficial experiments are made, and the truly useful results of experiment station work are materially reduced in number and importance. In saying this we do not wish to be understood as being in favor of confining the farm operations of the stations in all cases to small plats and a few animals. The size of the experimental field and the number of animals should depend on the nature and importance of the experiment as related to the funds available for this purpose. But it is clear that oftentimes stations attempt too many and too big field experiments and keep too large herds of animals. In these departments of the station business there is the greatest need for trained experts, careful planning, thorough execution, and economical management. \* \* \*

#### RELATIONS OF COLLEGES AND STATIONS.

There is still some difficulty in securing a proper adjustment of the salaries and work of officers employed in both college and station. Teaching involves the regular performance of routine duties, which constitute a drain upon the energies of the teacher that can not easily be measured by the time spent in the class room. The value of the best performance of either teaching or experimenting can not be estimated in terms of the hours actually spent at the task. The essential thing is that the worker, whether teaching or experimenting, shall have such full command of his time and energies as to secure the best results of which he is capable. As things actually exist in the land-grant institutions, it is believed that in some cases the station is practically defrauded, and in other cases the arrangement does not give satisfactory results to either college or station. There is need of more careful attention to this subject on the part of governing boards. In a few instances the governing board has shown a disposition to impose teaching duties on station officers without paying any portion of their salaries from college funds. This is plainly a violation of the Hatch Act and should be resisted. \* \* \*

While a thoroughly satisfactory state of things as regards the relations of the

stations to the colleges has not yet been reached, much progress has been made in this direction. The officers of the stations are, as a rule, in harmony with the Department on this question, and the views of the members of the governing boards who have had any experience in dealing with this matter are becoming more definitely settled in right lines.

#### BAD EFFECTS OF FREQUENT CHANGES OF OFFICERS.

In one respect the past year has been a period of unusual discouragement to those who have the best interests of the experiment stations at heart. From changes in the constitution of the governing boards, due to legislative action, changes in the governors having power of appointment or removal of members of these boards, and other causes, the directors of the stations in ten States and Territories have been changed since the last report was prepared. In several cases the directors removed had had long and successful experience in the management of the stations and had made their work increasingly useful. In these and other cases removal of the director was accompanied by a further reorganization of the station staff. When we consider the comparative scarcity of well-trained men who are thoroughly competent to conduct experimental inquiries, the numerous changes in the personnel of the station staffs during the past year is quite disheartening. Thorough agricultural investigations require long and persistent effort, in accordance with a careful plan consistently followed, it maybe, for years before a final and satisfactory result is reached. Nothing could have a more powerful tendency to keep good investigators away from our stations and to produce a structural weakness in their operations than a vacillating policy of management. Station officers should be chosen for their fitness and ability as determined by the standards of their profession, and they should be made secure in their positions as long as neither their reputations nor their efficiency are condemned by competent and impartial critics. Educational institutions are always weak when their officers are frequently changed, and an atmosphere of uncertainty pervades their operations. The case is even worse with institutions for original research like the experiment stations. Political and personal considerations are absolutely out of place in determining the appointment and continuance of college and station officers. Wherever a community permits changes in the station staff for such reasons, it condemns itself to suffer from the relative weakness of its station. There is great need that the intelligent farmers and other friends of the stations should come to their aid in this regard and insist on their maintenance of the policy which experience clearly shows alone can secure their success.

The numerous changes in the station staffs recently made are calculated to shake faith in the wisdom of committing the stations so fully to the control of the local boards. Violent and unreasonable changes in one or two stations tend to produce an unsettled feeling among the whole body of station workers throughout the country. Already there is considerable sentiment in favor of extending the functions of the National Government in the supervision of the stations so far as to secure more permanent tenure of office for the investigators. It will be far better if the local appointing officers and boards will recognize their plain duty in this matter and take such action themselves as will defend the funds committed to their care by the nation from being wasted in the frequent shifting of the charge of the stations from one set of men to another, so that the carrying out of thorough investigations is practically impossible. It should be clearly understood that under existing conditions this Department can do comparatively little to help the stations where frequent changes are occurring in the personnel of the governing boards and station staffs. The chief benefit which the stations may derive from the advisory relations of this Department to them will grow out of such personal intercourse between the officers of the Department and of the stations as will admit of intelligent discussion of local problems of station business as related to the teaching of experience regarding the management of agricultural investigations, viewed from the impartial standpoint of the central office. There must also be opportunity for the Department to explain its policy regarding the stations and to answer objections arising from the seeming necessities imposed by the local environment. When the membership of governing boards and station staffs changes rapidly inexperience often leads to precipitate action before the Department can be heard in the matter, and its previous efforts to advance the interests of the station are rendered entirely nugatory. Until the affairs of some stations become more settled there is little prospect that any remedy can be found for the weaknesses from which they are evidently suffering.



## EVIDENCES OF THE SUCCESS OF THE STATIONS.

The past year has brought out many encouraging evidences of the strength of the stations in the confidence and support of the farmers, based on the aid which they are actually giving to agricultural enterprises through their experiments and their publications. The States have, in many instances, continued or enlarged the appropriations for the stations in addition to the funds given by the National Government. Many of the States pay the printing bills, which are everywhere a growing item of station expense. Others have given considerable funds for the erection or enlargement of station buildings. The equipment of the stations is everywhere steadily improving. As a rule, the expert officers of the stations working along scientific lines are receiving a larger measure of encouragement than ever before. The importance and authority of the station officers as experts whose knowledge and judgment may be safely relied upon to aid in the enforcement of laws to protect the farmer from fraud or injury have been increasingly recognized. The stations have for years performed very important and valuable services in connection with the control of the sale of commercial fertilizers. Laws recently passed in a number of States impose upon them similar duties regarding feeding stuffs, dairy products, nursery stock, or injurious insects. Indeed, the danger is that our stations will be overloaded with routine and police duties and the demands upon them to act as bureaus of information. There has been no more notable indication of the rapid increase of original investigation in this country than is shown in the remarkable development of scientific effort in agricultural investigations at some of our best experiment stations. Success has brought confidence, and the people are most heartily supporting those stations which are doing the most thorough work. There is every reason to believe that in agricultural research, as in other lines of scientific inquiry, the useful results will accumulate in increasing ratio, and that the foundations are being laid for far wider success in the not far-distant future. \* \* \*

## CORDIAL RELATIONS BETWEEN THE DEPARTMENT AND THE STATIONS.

The development of cordial relations between the stations and this Department has presented many encouraging and gratifying features. It has been the aim of the Department to bring to the stations the results of a wide and impartial view of the general principles of station management as wrought out by experience in such affairs at home and abroad, and to aid in adapting these principles to the conditions of local environment through personal conferences with station officers. Study and discussion of the many perplexing problems of station business have been profitable in many ways. Without in the least interfering with the free choice and execution of enterprises suited to the agriculture of their several localities, it has been found possible to do much toward making the individual stations feel that they are truly parts of a great national system of institutions working for the benefit of the agriculture of the whole country. The stronger stations have shown a kindly disposition to aid the weaker ones in developing their work, and by a certain spirit of self-restraint have exerted a powerful influence toward keeping the station enterprise within right lines. On the other hand, the stations handicapped by limited resources and other unfortunate conditions, have, in many instances, made gallant efforts to raise the grade and strength of their enterprises. And in general there has been a growing appreciation of the fact that "if one member suffer, all the members suffer with it."

Much progress has also been made in the organization of cooperative enterprises between the stations and different branches of this Department along some lines. In such arrangements the Department contributes funds for special investigations to be carried on in different parts of the country, furnishes materials collected in this and other countries, or gives the stations the benefit of expert advice or general supervision in particular directions. The stations, on their part, give laboratory facilities, expert services, or organization and supervision of details of investigations and, what is often most essential and valuable, secure the intelligent cooperation of practical agriculturists in their several communities. In this way the funds of both the Department and the stations are most economically and efficiently employed for the general benefit of our agriculture. Cooperative experiments of this character have been conducted the past year with sugar beets, forage plants, and grasses, on soils, in forestry, and on problems relating to the food and nutrition of man. \* \* \*

## STATISTICS OF THE STATIONS.

Agricultural experiment stations are now in operation under the act of Congress of March 2, 1887, in all the States and Territories. Alaska is the only section of



the United States which has no experiment station. A preliminary investigation regarding the feasibility of conducting agricultural experiments in Alaska has, however, been made by the Department this year. In each of the States of Alabama, Connecticut, New Jersey, and New York a separate station is maintained wholly or in part by State funds, and in Louisiana a station for sugar experiments is maintained partly by funds contributed by sugar planters. Excluding the branch stations established in several States, the total number of stations in the United States is 54. Of these, 52 receive the appropriation provided for in the act of Congress above mentioned. The total income of the stations during 1897 was \$1,129,832.99, of which \$719,993.47 was received from the National Government, the remainder, \$409,839.52, coming from the following sources: State governments, \$287,176.35; individuals and communities, \$5,553.88; fees for analyses of fertilizers, \$37,265.26; sales of farm products, \$64,437.83; miscellaneous, \$16,906.20. In addition to this, the Office of Experiment Stations had an appropriation of \$35,000 for the past fiscal year, including \$5,000 for the Alaskan investigation. The value of additions to equipment of the stations in 1897 is estimated as follows: Buildings, \$74,830.99; libraries, \$12,993.25; apparatus, \$21,149.73; farm implements, \$13,178.25; live stock, \$14,733.07; miscellaneous, \$7,714.08; total, \$143,599.38.

The stations employ 628 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 67; chemists, 134; agriculturists, 66; horticulturists, 71; farm foremen, 38; dairy-men, 19; botanists, 47; entomologists, 48; veterinarians, 30; meteorologists, 18; biologists, 8; physicists, 9; geologists, 6; mycologists and bacteriologists, 21; irrigation engineers, 6; in charge of substations, 11; secretaries and treasurers, 70; librarians, 9, and clerks, 38. There are also 30 persons classified under the head of "miscellaneous," including superintendents of gardens, grounds, and buildings, apiarists, herdsmen, etc. Two hundred and eighty-three station officers do more or less teaching in the colleges with which the stations are connected.

During 1897 the stations published 54 annual reports and 324 bulletins. Besides regular reports and bulletins a number of the stations issued press bulletins, which were widely reproduced in the agricultural and county papers. The mailing lists of the stations now aggregate 506,100 names. Correspondence with farmers steadily increases and calls upon station officers for public addresses at institutes and other meetings of farmers are more numerous than ever. The station officers continue to contribute many articles on special topics to agricultural and scientific journals.

The directors and accounting officers of the stations cordially responded to the request of this office for a return of the financial reports soon after the close of the fiscal year, and in this way it became possible for the director of this office to complete his report on the work and expenditures of the stations before January 1, 1898.

The schedules for the financial reports of the stations for the fiscal year ended June 30, 1898, as prescribed by the Secretary of Agriculture, have been forwarded to the stations, and the visitation of the stations with reference to the work and expenditures of that year is now in progress.

The experience of the past year has brought additional evidence of the value of the efforts which this office is making to keep in close touch with the stations. While the annual visitation of the stations throughout the country is a large and onerous task, yet it is believed that in no other way could the office so satisfactorily and efficiently perform its supervisory and advisory duties on behalf of the stations.

As a rule, the stations have enjoyed a year of undisturbed activity, and there has been much useful work accomplished. The specialization and differentiation of the work in different lines of agriculture, which are proceeding in the agricultural colleges (see p. 113), are also favorably affecting the work of the experiment stations. A considerable number of the States continue to pursue a liberal policy toward the stations and add materially to their financial resources; but, on the other hand, some States having large agricultural interests have not as yet sufficiently appreciated the importance of researches along agricultural lines to supplement, to any great extent, the national

funds given them for this purpose. The stations in these States are sometimes unjustly criticised because their operations are comparatively limited as compared with those of the stations located in more liberal communities.

Some flagrant cases of political interference in the management of the stations have been brought to our attention during the past year. In a number of States there is still great need of the awakening of the people to the realization of the fact that the State and national funds set apart for agricultural education and research are largely wasted because governing boards are changing their membership with every State election, and in the absence of any permanent policy for the management of these institutions the working force is laboring under great difficulties and is discouraged from forming or executing plans for the performance of the best and most useful work of which they are capable. In a few cases it has appeared that the State laws governing the colleges and stations are such as to render invalid any contracts which the governing boards may make with officers to secure their services for a longer term than one year. The agricultural colleges and experiment stations in those States will of course remain weak and inefficient as long as they are maintained on such false principles.

#### PUBLICATIONS OF THE OFFICE.

During the year the office issued 43 documents, aggregating 2,920 pages. These include 13 numbers of the Experiment Station Record, with detailed index, 12 bulletins, 7 Farmers' Bulletins (including 4 numbers of the subseries entitled Experiment Station Work), 1 circular, 4 articles for the Yearbook of the Department, the annual report of the director, a report to Congress on the work and expenditures of the experiment stations, and 4 special articles published as separates. It is believed that the limit of work in the preparation of publications which the office can creditably perform, with its present force and means, has been reached.

#### EXPERIMENT STATION RECORD.

The ninth volume of the Experiment Station Record comprises 1,214 pages, and contains abstracts of 317 bulletins and 56 annual reports of 53 experiment stations in the United States, 201 publications of the Department of Agriculture, and 842 reports of foreign investigations. The total number of pages in these publications is 56,569. The total number of articles abstracted is 1,810, classified as follows: Chemistry, 121; botany, 86; fermentation and bacteriology, 28; zoology, 31; meteorology, 57; water and soils, 72; fertilizers, 85; field crops, 153; horticulture, 138; forestry, 16; seeds and weeds, 41; diseases of plants, 107; entomology, 252; foods and animal production, 186; dairy farming and dairying, 151; veterinary science, 134; technology, 11; agricultural engineering, 38; statistics, 103. Classified lists of articles, in some cases with brief abstracts, are also given in each number. The aggregate number of titles thus reported is 2,471.

Special articles were also published in the Record as follows: "Agricultural associations in Belgium," by P. DeVuyt, assistant inspector of agriculture of Belgium; "The aims and tendencies of the German agricultural experiment stations," by M. Maercker, director of the agricultural experiment station at Halle, Germany; "The methods of determining the digestibility of feeding stuffs," by O. Kellner, director

of the agricultural experiment station at Möckern, Germany; "Agricultural education and research in the Scandinavian countries and Finland," by F. W. Woll, assistant professor of agricultural chemistry, University of Wisconsin; "Origin and formation of organic matter in plants," by P. P. Dehérain, member of the Institute of France; "The value of experiments on the metabolism of matter and energy," by C. F. Langworthy, of this office. There are condensed accounts of the proceedings of the fourteenth annual convention of the Association of Official Agricultural Chemists, 1897, and the eleventh annual convention of the Association of American Agricultural Colleges and Experiment Stations, prepared by W. H. Beal, of this office.

The review of the literature of agricultural science made in this volume of the Record is more complete than heretofore. Especial attention was given to extending the range of the abstracts of Russian and Italian reports of agricultural investigations. Experiment-station officers and other readers of the Record have often urged that a larger number of abstracts should be given and that the list of mere titles should thus be abbreviated. The desirability of this is clearly recognized by the editors of the Record, and efforts are constantly being made to extend our work in this direction. The labor involved in making careful and satisfactory abstracts of the more important articles published in different languages, taken in connection with the other duties imposed upon the members of the office force, will, however, make it impracticable for us to materially increase the number of abstracts prepared for any one volume of the Record without further increase in the number of editorial workers. The material on hand to be examined with reference to abstracting is constantly increasing in amount and variety, and there is more and more perplexity regarding the limitations which should be put on the range of the subjects to be included in the Record. Each year brings additional testimony regarding the value of such a review of the literature of agricultural science as the Record attempts to give, and it is believed that the importance of this work as related to the success of our investigators in the Department, the experiment stations, and kindred institutions fully justifies the expenditure of sufficient labor and means to make this review complete and satisfactory. The relatively large number of copies of the Record sold by the Superintendent of Documents is a gratifying evidence that its value is appreciated outside the ranks of those to whom it seems proper to extend its gratuitous distribution.

#### TECHNICAL BULLETINS.

A Digest of Metabolism Experiments (Bulletin No. 45), prepared by W. O. Atwater, special agent in charge of nutrition investigations, and C. F. Langworthy, editor of the department of foods and animal production of the Experiment Station Record, contains tabulated summaries and abstracts of reports of about 3,600 experiments in which the balance of income and outgo was determined. This work, which represents a vast amount of painstaking research, was begun in connection with the investigations on the nutrition of man and was continued and completed in this office, when it became apparent that it was very desirable to include in it the experiments with domestic animals as well as with man. In this way a large amount of information was collated which will be of great service, not only to investigators and students of human nutrition, but also in connection with



the work of experiment stations and kindred institutions in the establishment of a scientific basis for the feeding of live stock on the farm. It is believed that the investigations in the feeding of animals conducted at our experiment stations are rapidly nearing the point where it will be essential to make researches along the lines set forth in this bulletin, if feeding experiments are to continue to be useful in promoting the advancement of our agriculture. Some of the ways in which the methods and results of metabolism experiments may be employed to develop the work of our stations on the problems of the nutrition of domestic animals have been set forth in a special article in the Experiment Station Record, prepared by Dr. Langworthy, after the completion of his work on the digest of these experiments.

Organization Lists of Agricultural Experiment Stations and Institutions with Courses in Agriculture (Bulletin No. 47) contains a list of experiment stations in the United States, with their governing boards and working staffs; a list of agricultural schools and colleges in the United States, with courses of study and boards of instruction; a list of officers of the Association of American Agricultural Colleges and Experiment Stations, and of the Association of Official Agricultural Chemists of the United States; a list of station publications received at this office during 1897; Federal legislation affecting agricultural colleges and experiment stations, and regulations and rulings of the Federal departments affecting the stations.

A Report to Congress on Agriculture in Alaska (Bulletin No. 48) includes the reports of Walter H. Evans, Benton Killin, and Sheldon Jackson, made to the director of this office, as described in the account of the Alaska investigations given on page 117 of this report.

The Proceedings of the Eleventh Annual Convention of the Association of American Agricultural Colleges and Experiment Stations, held in Minneapolis, Minn., July 13-15, 1897 (Bulletin No. 49), contains, in addition to the proceedings of the convention, papers, addresses, and reports on a number of subjects of interest to students and investigators in agricultural science. The stenographic report of these proceedings was made under the supervision of this office, and the proceedings were edited for publication by the director of this office and the chairman of the executive committee of the association.

A Report on the Work and Expenditures of the Agricultural Experiment Stations for the year ending June 30, 1897 (Bulletin No. 50), contains the report of the director of this office described on page 103.

Statistics of the Land-Grant Colleges and Agricultural Experiment Stations in the United States for the year ending June 30, 1897 (Bulletin No. 51), is a compilation showing the number of officers and students, endowment, equipment, and revenue of the colleges, and the number of officers, revenues, expenditures, lines of work, and number of publications of the stations in more complete form than hitherto published by this Department.

A brief statement regarding other bulletins issued in connection with the work in nutrition investigations may be found on page 121.

#### FARMERS' BULLETINS.

Milk as Food (Farmers' Bulletin No. 74) contains brief summaries of information on the characteristics, composition, properties, nutritive value, and digestibility of milk and the ways in which milk may be combined with other foods to make dietaries of different nutritive values and cost. In the preparation of this bulletin the results of the



nutrition investigations in charge of this office were utilized, as well as information gathered from other authoritative sources.

Tomato Growing (Farmers' Bulletin No. 76) contains practical information regarding the growing of tomatoes in the field for the market and for canneries and in the greenhouse, based on the investigations and observations made by the author, Prof. E. B. Voorhees, at the New Jersey Experiment Station, as well as those made at other experiment stations and elsewhere. Brief notes on the fungous enemies of the tomato, by Prof. Byron D. Halsted, botanist and horticulturist of the New Jersey Agricultural Experiment Station, are also included.

The Liming of Soils (Farmers' Bulletin No. 77), by Dr. H. J. Wheeler, chemist of the Rhode Island Agricultural Experiment Station, contains a useful summary of information regarding the methods and effects of the application of lime to soils and the forms of lime used for agricultural purposes. The author of this bulletin has of late been giving much attention to the study of problems relating to the use of lime in agriculture.

#### POPULAR RÉSUMÉS OF EXPERIMENT STATION WORK.

Experiment Station Work II, III, IV, V (Farmers' Bulletins 65, 69, 73, 78) are four numbers of a subseries of brief popular bulletins compiled from the published reports of the agricultural experiment stations and kindred institutions in this and other countries. Each of these bulletins contains a number of short articles, summarizing the results of recent investigations in different lines and explanations of the technical terms necessarily employed in describing the results of investigations on certain subjects. As stated in the prefatory note in each number, "the chief object of these publications is to disseminate throughout the country information regarding experiments at the different experiment stations and thus to acquaint our farmers in a general way with the progress of agricultural investigation on its practical side." In order to make these articles most interesting and useful to farmers, it has been deemed essential to make them something quite different from ordinary abstracts of single articles or bulletins. It is often necessary to interweave skillfully the results obtained in several investigations; explanations of the local and other limitations of the results of certain experiments must be made, and in general such explanatory matter must be introduced as will make each article a clear and intelligible presentation of the subject to the farmer reader. Popular composition of this description, which combines scientific accuracy with a clear and entertaining style, is, of course, a difficult task. We believe, however, that every reasonable effort should be made to provide our farmers with the best attainable products of editorial and typographical work. As was expected, the real purpose and value of this new series of popular bulletins were not at first fully understood, but as the number in the series has increased, the demand for the different issues has rapidly grown. It is proposed to publish an index to the different numbers as often as the number of subjects will warrant. In this way, recipients of this series who preserve and bind together the several volumes with the indexes will have a readily accessible store of information on a large number of subjects directly related to farm practice. The aim will be to provide our farmers with a popular record of the progress of agricultural research. How useful this will be to them will of course depend

largely on the care which they take to secure, read, and preserve the bulletins provided for their benefit.

Now that many preliminary questions regarding the form and content of Experiment Station Work have received much consideration, it is hoped that it will be possible to increase the annual output of numbers of this series. This can not, however, be done to any considerable extent with the force at present available for this work.

#### CARD INDEX.

Copy for 2,500 cards of the Index of Experiment Station Literature has been prepared in this office and forwarded to the printer during the year. The number of index cards distributed has reached 16,500. The receipts from sales of this index during the past year have been \$232.40.

#### BIBLIOGRAPHICAL WORK.

A list of 449 works on agricultural subjects, most of which were issued during the past two years, was prepared, together with brief statements showing the scope and character of the books included in this list. This was in continuation of the list published in Circular No. 31 of this office. In this undertaking the office has, as hitherto, received the cordial cooperation of the Librarian of the Department and his assistants.

The office has continued to collect and catalogue the publications of the agricultural colleges and experiment stations in this and other countries. The number of exchanges of foreign publications containing reports of agricultural investigations which have been received and transmitted to the Department Library has been fully as large as heretofore. The receipt in the Library of several thousand numbers of periodicals from all parts of the world has been brought to the attention of the editorial force engaged in the preparation of the Experiment Station Record.

#### DISTRIBUTION OF PUBLICATIONS.

Especial attention has been given during the past year to the revision of the mailing lists used in the distribution of the Experiment Station Record to officers and libraries of foreign institutions. The lists of colleges, schools, and benevolent and reformatory institutions to which the publications of the office on nutrition investigations are regularly sent have been considerably extended. The supervision of the mailing lists used in the distribution of publications issued by different divisions of the Department to experiment stations and other institutions has been continued. The official mailing list of experiment-station officers has been furnished, as heretofore, on demand, to the experiment stations throughout the country for use in the distribution of their publications.

#### NEED OF BETTER OFFICE ROOMS.

While the Office of Experiment Stations is better situated as regards office rooms than some of the other divisions of the Department, its work is, nevertheless, carried on with much embarrassment on account of lack of rooms suited to the kind of employment in which its officers are engaged. The director has no separate office in which to perform

such work as could best be done apart from the general routine business. He is thus subject to constant interruptions from visitors and to such annoyances as are necessarily incident to the conduct of the general business of the office in the room in which he has his desk. The rooms of his assistants are inconveniently separated from the main office, thus necessitating very frequent communication by telephone or messenger. One of these rooms contains the desks of seven editors and clerks who are thus necessarily deprived of that quiet and retirement ordinarily deemed essential to the best performance of such services as those in which they are engaged.

Every year increases the relative disadvantage under which the work of the Department is done as compared with the facilities in the best class of State and private establishments where similar operations are conducted.

#### RELATIONS WITH AMERICAN INSTITUTIONS FOR AGRICULTURAL EDUCATION.

During the past year this office has somewhat extended its work in the direction of collating and publishing information regarding the agricultural colleges and promoting their work. More complete statistics regarding the agricultural colleges have been published. Representatives of the office in connection with their visits to the stations have not only had many opportunities for observing the educational work the colleges are doing in behalf of agriculture, but have also been called upon to give advice regarding the development of this work.

The financial and statistical reports of the colleges receiving appropriations under the act of August 30, 1890, which, in accordance with the law, are regularly forwarded to the Secretary of Agriculture, have as hitherto been deposited in this office, the last reports received being for the fiscal year ending June 30, 1898.

At a number of colleges there has been considerable improvement during the year in the buildings and equipment used in connection with instruction in agriculture. This has notably been the case at the Ohio State University, where the erection of a building costing some \$100,000, with interior arrangements and equipment made in accordance with the most approved designs, is a most encouraging evidence of the increased interest in agricultural education taken by our larger State institutions. It is also evident that the subdivision of the subject of agriculture and the employment of professors and other teachers in the several branches of agriculture is proceeding with considerable rapidity. Thus far this tendency is most clearly shown in the separation of plant production, or agronomy, from animal husbandry, or zootechny. Dairying is also taught by a separate instructor in a number of institutions and in a few instances sheep husbandry is made a separate chair. Departments of soil physics with separate laboratories have been established in a number of institutions. The improvement in the equipment and methods of instruction used in connection with courses in agriculture in our colleges is attracting a better class of students.

Meanwhile the movement for the extension and popularization of agricultural instruction is constantly gathering strength. The short and special courses in the colleges, the farmers' institutes, and the home reading circles have had a larger number of students than ever before. The effort to introduce nature teaching into the common



schools has continued to grow not only in New York, where the work is being actively prosecuted under the leadership of the College of Agriculture, Cornell University, but also in other States. With a view to aiding in the diffusion of information regarding this movement in behalf of elementary agricultural education, the director of this office prepared an article on "Popular education for the farmer," which was published in the Yearbook of the Department for 1897. The standing committee on methods of teaching agriculture, appointed by the Association of American Agricultural Colleges and Experiment Stations, of which the director of this office is a member, has continued its labors during the past year and will make a report at the coming meeting of the association this fall.

Now that our agricultural population as well as our people generally are beginning to appreciate the importance of technical education in the arts and industries, it would seem to be the duty of this Department to engage more actively in efforts to promote the interests of such education. The fact that our country is growing into closer relations with the rest of the world makes it more imperative that systems of technical education shall be elaborated to meet the peculiar needs of our people and that ways and means shall be devised to bring such education within reach of the masses of the people. The Department of Agriculture, sustaining close relations with the workers on the farms and with the educational institutions already established for their benefit, is in a better position than any other Government agency to extend efficient aid to the cause of agricultural education. If the Department had a small corps of workers who could devote their time to the collection of information and to the study of the problems of agricultural education in this and other countries and could disseminate such information through the agricultural press, the farmers' institutes, and in other ways, much good might be accomplished.

#### RELATIONS WITH FOREIGN INSTITUTIONS FOR AGRICULTURAL EDUCATION AND RESEARCH.

During the past year an effort has been made to put into some systematic form the information which this office has received regarding the institutions for agricultural and educational research in foreign countries. This work has shown that while we receive from time to time a considerable number of publications and much general information regarding these institutions, we do not as yet have as complete and satisfactory records regarding their organization, equipment, and work as is very desirable for the Department to possess. It has also appeared that the task of obtaining this complete information and keeping it up to date is a much larger one than was at first supposed. Under present conditions, the office is not in a position to extend materially its work in this direction, but it is hoped that the way will be open to secure this desirable end in the very near future.

#### ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The eleventh annual convention of this association was held at Minneapolis, Minn., under the auspices of the University of Minnesota, July 13-15, 1897. The director of this office was a delegate from



the Department. The chief of the Division of Chemistry, the first assistant of the Division of Botany, and the assistant director of this office were also in attendance and took an active part in the deliberations. The director of this office was reelected bibliographer of the association. The stenographic report of the proceedings was prepared under his supervision by Mr. R. M. Reese, of this Department, and has since been edited by the director and the chairman of the executive committee of the association and issued as Bulletin No. 49.

The following resolutions relating to this Department and to the experiment stations were adopted:

The publications of the General Government and its several Departments being of especial value in the work of the land-grant colleges and stations, it is hereby moved,

That the executive committee of this association be asked to take such steps as by legislation or otherwise will create each of the land-grant colleges a depository of all Government publications, including all past publications as far as possible.

*Resolved*, That a committee of five be appointed by the president to investigate, consider, and, if practicable, devise a plan whereby graduate students of the land-grant and other colleges may have access to and the use of the Congressional Library and the collections in the Smithsonian Institution, the National Museum, and the scientific bureaus of the various Departments, at Washington, of the United States Government, for the purposes of study and research; said plan to include suggestions as to the manner in which such work may be organized, coordinated, and directed, to the best advantage; the composition and organization of such a staff as may be necessary to properly coordinate and direct such work, and also an outline of such legislation as may be necessary to effect the general purposes of this resolution; said committee to report at the next meeting of the association.

Whereas one of the principal requisites of successful agriculture is the use of seed for sowing which is free from obnoxious weeds, of good vitality, and true to name; and

Whereas there are thousands of pounds of trashy seed annually imported into and sold in the United States, especially seeds of grasses, clovers, and other forage plants; and

Whereas at the present time the agriculturists of this country frequently labor under great disadvantages in obtaining pure germinable seed, thereby entailing extraordinary loss and trouble: Therefore, be it

*Resolved*, (1) That this association earnestly recommends that some practical instruction in seed testing and seed investigation be offered at each of our agricultural colleges, and that the experiment stations equip themselves for investigations in seed testing, following, so far as may be found practicable, the rules and methods adopted by this association and published in Circular 34 of the Office of Experiment Stations.

(2) Furthermore, we recommend that one or more lectures on agricultural seeds, and the best means for ascertaining the real value of the same, be given at our farmers' institutes, and that the importance of this subject be urged upon all suitable occasions.

(3) We heartily indorse the efforts of the United States Department of Agriculture, by means of its pure-seed investigations, to secure an improvement in the quality of agricultural seeds, and we recommend that the experiment stations and agricultural colleges cooperate with the Department in this work.

*Resolved*, That we urge upon the United States Department of Agriculture the importance of extending its collection of fruits and other economic plants by the addition of specimens showing foliage, flowers, or other parts, and of photographs showing typical trees or plants of all varieties offered for sale, in order to aid in the description of varieties and in the study of plant variation, as well as to discourage the duplication of names, and to secure due recognition to the originators of valuable varieties, and that there may be some one place where all varieties placed upon the market may be officially registered, numbered, and described.

The next meeting of the association will be held at Washington, D. C., in November, 1898.

AGRICULTURAL SCHOOLS AND EXPERIMENT STATIONS IN HAWAII,  
PUERTO RICO, ETC.

The events of the past year have, in my judgment, made it very desirable that the question of the establishment of agricultural schools and experiment stations in Hawaii, Puerto Rico, and other possessions which the United States may permanently acquire in the near future, should be carefully considered by Congress at its coming session, and that provision should at least be made for the thorough investigation of the conditions of the population and agriculture of these regions, with reference to the desirability and feasibility of the establishment of agricultural schools and experiment stations in these territories. It requires no argument to show that agriculture will be the leading industry in these islands for many years. It is well known that their agriculture has thus far been practiced in accordance with comparatively rude methods and that the education of the population engaged in agriculture has been very limited. There is every reason to suppose that the agriculture of these territories may be vastly developed by the introduction of improved methods and the education of the people. The importance of technical education in agriculture and of experimental inquiries for the benefit of this art is now universally acknowledged. A notable instance of the recognition of this fact in the development of national resources has been seen in recent years in Japan, where agricultural colleges and experiment stations have been thoroughly organized and have already accomplished much good work.

In Hawaii beginnings have already been made in the establishment of institutions for agricultural education and research. An experiment station was established at Honolulu in 1894 by the Hawaiian Sugar Planters' Association, and Dr. W. Maxwell, a chemist formerly employed in the Division of Chemistry of this Department and afterwards in the Louisiana Agricultural Experiment Station at New Orleans, was made its director. Investigations on soils, fertilizers, the culture of sugar cane, the manufacture of sugar, and other subjects have been made, and several reports and bulletins have been issued. This Department has recently received information that an agricultural department has been established in the Kamehameha Manual Training School at Honolulu, and Mr. T. F. Sedgwick, formerly in charge of the Southern Coast Range Experiment Station of California, has been appointed instructor in agriculture and horticulture. It is believed that it will be wise economy to undertake, without delay, the examination of the agricultural conditions in the new possessions of the United States, with a view to the establishment of a system of institutions for educational and agricultural research, suited to the peculiar requirements of their agriculture and people. Without doubt this Department will need to carry on special investigations in these countries as it does in the States and Territories of the United States where agricultural colleges and experiment stations are already in operation. But there should be separate and careful consideration of the problems relating to the needs of these islands as regards institutions for agricultural education and research.

## EXPERIMENT STATIONS IN ALASKA.

The first appropriation "to enable the Secretary of Agriculture to investigate and report to Congress upon the agricultural resources of

Alaska, with special reference to the desirability and feasibility of the establishment of agricultural experiment stations in said territory and the selection of suitable locations for such stations," became available July 1, 1897. A commission, consisting of Mr. Benton Killin, a member of the board of regents of the Oregon Agricultural College, and Dr. Walter H. Evans, botanist of this office, visited the coast and island region of Alaska from its southern boundary as far north as Unalaska. Stops were made at a considerable number of villages and other places where information could be obtained regarding what had already been done in agriculture in this region and what were the opportunities for its further development. Collections were made of soils and of native plants, especially those used for food and forage. Data were obtained regarding the general topography, climate, and soils; natural and cultivated products and methods of cultivation; stock raising; area of arable lands; agricultural difficulties and possibilities; desirability of experiment stations, and the locations suitable for them. A large and valuable collection of the plants of the region visited was obtained by Dr. Evans, including a considerable number of species hitherto unknown. A large number of photographs were also taken, showing the general aspects of the region and illustrating the grass lands, gardens, forests, and agricultural products. Through the courtesy of the honorable Secretary of the Interior and the Commissioner of Education the services of Dr. Sheldon Jackson, the superintendent of Government schools in Alaska, were secured to investigate the agricultural capabilities of the Yukon Valley in connection with his annual inspection of the Alaska schools. Dr. Jackson traveled the entire length of the Yukon River as far as Dawson, a distance of 1,652 miles, and collected much interesting information regarding the attempts in growing vegetables at a number of places in this region, and made collections of native plants, especially berries and grasses. Specimens of vegetables and small fruits, in no way inferior to those grown elsewhere in the United States, were collected in different parts of Alaska, and analysis of the grasses which grew very luxuriantly in many localities in that region showed them to be fully as nutritious as those produced in the most favored agricultural regions of this country. The reports of our agents, prepared under the direction of the director of this office, were transmitted to Congress last December and were published as Document No. 160 of the House of Representatives, Fifty-fifth Congress, second session, and afterwards as Bulletin No. 48 of this office (see p. 110).

By reason of the showing made of the agricultural possibilities of Alaska and the feasibility of carrying on useful agricultural investigations in that region, Congress continued the appropriation for the current fiscal year under the same terms as before, with an increase in the amount from \$5,000 to \$10,000. As soon as this appropriation was made plans were formed for continuing the investigations. Prof. C. C. Georgeson, a native of Denmark, and thoroughly familiar with the conditions of agriculture in northern Europe, who had had a long experience as professor of agriculture and experiment station worker

Japan and Kansas, was transferred to this office from the Division of Agrostology of this Department and made special agent in charge of the Alaska investigations. At the same time the Weather Bureau of this Department undertook the establishment of a special meteorological service for Alaska. In this way this office has enjoyed the cordial cooperation of the Weather Bureau in the Alaska work, and the aid which has been given us by the chief of that bureau and



his assistants has been of great service in our investigations. We have also enjoyed the hearty support of the governor of the Territory, Hon. John G. Brady.

Only about \$1,000 of the first appropriation remained unexpended after the report to Congress had been prepared. Nearly all this amount was required to pay the salary of the agent in charge and his traveling expenses to Sitka, so that comparatively little work could be undertaken until after July 1, 1898. From the fact that the second appropriation was unavailable until that date, our operations during the present season of plant growth have been greatly hampered. The disorganization of the transportation service between Puget Sound points and Alaska, largely due to the withdrawal of steamers for service in the war with Spain, has also caused embarrassing delays in the transaction of our business. It was arranged that headquarters for the work of this office and the Weather Bureau should first be established at Sitka. April 16 Professor Georgeson left Washington, D. C., but, owing to delay at Seattle, did not arrive at Sitka until May 12. Mr. Ball, observer of the Weather Bureau in charge of the Alaska service, reached Sitka about May 3. It was hoped that they might obtain quarters in the Government building at Sitka, but this did not prove feasible. After some difficulty they secured a temporary lease of a small house, which, however, was poorly suited to the requirements of their work. Arrangements were made with several persons having gardens in Sitka by which Professor Georgeson was enabled to make experimental plantings of seed of over 100 varieties of vegetables, grasses, and forage plants which he had taken with him for that purpose. Seeds had previously been distributed to a number of different localities in Alaska, and agreements for cooperative experiments in a number of places have since been made. The building of a silo for the preservation of native grasses and the feeding of the silage to some horses and cattle has been arranged for on a farm in the vicinity of Juneau. Letters of inquiry have been sent out to obtain information regarding crops, methods of culture, keeping of animals, and the agricultural possibilities of different localities.

After careful examination, Castle Hill, a lot in Sitka which a number of years ago was set aside as a site for Government buildings which were afterwards located elsewhere, has been reserved, by an order of the President, as a proper place on which to erect a building to serve as headquarters for the experiment station and weather service in Alaska. This lot is on high ground, which makes it especially valuable for meteorological observations, and it is a convenient location for a building to contain the offices and laboratories of an experiment station. About 110 acres of partly cleared land has also been reserved in the immediate vicinity of Sitka, from which sufficient areas for experimental purposes can be prepared at relatively small expense. Professor Georgeson is at present engaged in the exploration of the Kenai Peninsula, which, it is believed, presents unusually good opportunities for agricultural development. Lands which may be used for experiment stations will be reserved on this peninsula and also on Kadiak Island, where it is hoped that some experiments in the raising of live stock may hereafter be conducted.

June 7 Dr. Evans proceeded to Alaska and has since been engaged in continuing the botanical survey of the region in the vicinity of Sitka and in Cook Inlet. It is expected that both Professor Georgeson and Dr. Evans will prepare reports of their work for transmission to Congress at its coming session.



It is believed that through the work of our agents in Alaska the present season we shall be able to make arrangements for carrying on cooperative experiments in a number of different places in Alaska next year, and that the foundations will have been laid for the active cooperation of residents of Alaska in advancing the work of the Department in that Territory. Definite plans will also be made for investigations in a number of different lines under the immediate direction of our agents on the lands reserved for experimental purposes. To accomplish results of any value, it will of course be necessary to plan these investigations to cover a series of years. Until the investigations have been in progress for some time, comparatively little of practical importance can be obtained from them. The experiments and observations made in the field should be supplemented by work in the laboratory. It is very desirable, therefore, that the experimental investigations in Alaska should be put on the same basis as regards buildings and equipment as in other parts of the United States. Definite provision for the erection of buildings should be made in the next appropriation bill. It is also very desirable that experiments with live stock should be undertaken in the near future. Account should be taken of the fact that the points at which experimental inquiries are desirable in Alaska are widely separated and that an agricultural survey of the region involves relatively large transportation expenses, especially when journeys are made into the interior, since there are no roads or regular land transportation. I therefore recommend that the appropriation for Alaskan investigations for the ensuing year be increased to \$15,000, provision to be made by which the sum thus appropriated may be used to pay expenses which may be incurred for the employment of assistants, clerks, laborers, and such other persons as the necessities of the work may demand; the use and preparation of land for experimental purposes; the erection and rental of buildings; traveling; camping outfits; the purchase of apparatus, implements, and supplies; the preparation, illustration, and distribution of bulletins and reports; the purchase and distribution of seeds and plants; the purchase and care of animals; and, in general, the payment of any expenses which may be found essential in carrying on agricultural investigations in that region. The appropriation for the Alaskan investigations should be made immediately available, in order that active operations may be begun and prosecuted during the growing season commencing with the spring of 1899.

#### NUTRITION INVESTIGATIONS.

The appropriation for investigations "upon the nutritive value of various articles and commodities used for human food" was continued by Congress for the past fiscal year, and the supervision of the work performed under this appropriation remained in charge of this office. The services of Prof. W. O. Atwater as special agent in charge were also retained. The policy pursued in the management of these investigations has been the same as that heretofore followed. The cooperation of the agricultural experiment stations, agricultural colleges, and other educational institutions was obtained in a way by which the Department secured the services of experts and laboratory and other facilities for its work on very advantageous terms. Wherever the cooperating institution has shown special interest in this work, the purpose has been to make this institution a center of nutrition investigations, and to specialize the operations there in the direction in which

it is found that that particular institution can work to the greatest advantage. Investigations on bread and cereals have been carried on in Maine, at Orono, in cooperation with the University of Maine; in Minnesota, at Minneapolis, in cooperation with the University of Minnesota; in New Jersey, at New Brunswick, in cooperation with the New Jersey State Experiment Station; digestion experiments with men in Tennessee, at Knoxville, in cooperation with the University of Tennessee; dietary studies in California, at Berkeley, in cooperation with the University of California; in Illinois, at Champaign, in cooperation with the University of Illinois; and in Virginia, at Hampton, in cooperation with the Hampton Institute. A special study of the dietaries of the boat crews of Harvard and Yale universities while in training for their annual race was made, with the cooperation of the authorities of those institutions. A technical investigation on the question as to how far nonprotein nitrogenous bodies are capable of undergoing oxidation in the human body and thus contributing to the production of energy was made in Virginia, at Charlottesville, in cooperation with the University of Virginia. Reports were also prepared on the instruction regarding food and nutrition of man, given in the public schools of New York City, on the usefulness of sugar as food, on dietary studies in the industrial districts of Chicago, and on fish as food.

The special investigations of the bomb and respiration calorimeters carried on in Connecticut, at Middletown, in cooperation with the Wesleyan University and the Storrs Experiment Station, under the immediate direction of the special agent in charge, have been continued. A considerable number of respiration experiments with human subjects, in which the perfected form of the respiration calorimeter was used, were made during the year. Arrangements were made for investigations with reference to the further development of the respiration calorimeter, so as to secure the direct measurement of the income and outgo of oxygen, as well as of carbon, nitrogen, and hydrogen. The measurements of heat and energy made by this apparatus in recent experiments have been unusually accurate and satisfactory.

The demand for publications on subjects relating to the nutrition investigations has largely increased during the past year, and the correspondence conducted in the offices at Washington and Middletown on matters relating to the food and diet of our people has grown to large dimensions. There have been many indications that public interest in these inquiries is widespread. Among the gratifying evidences of the success which has attended them has been the appointment of our special agent in charge as consulting expert to the lunacy commission of the State of New York on the food and diet of the insane. In connection with its other duties this commission is charged with prescribing the diet for inmates of the asylums for the insane throughout the State. The department of health of the city of New York is arranging to issue circulars of practical information regarding the nutritive value and preparation of foods for general distribution in that city. The schools and courses of instruction in which special attention is given to the study of the food and nutrition of man are rapidly increasing in number and importance. This office is making a special effort to aid in the dissemination of the results of the nutrition investigations among teachers and students in schools of all grades throughout the country.

A considerable amount of unpublished data has been accumulated, much of which will be included in bulletins to be offered for publication by the Department during the current fiscal year. Arrangements

have been made for the active continuance of the nutrition investigations in different parts of the country during the present year in accordance with the general plan hitherto followed. There is every reason to expect continued and enlarged success in these investigations.

## FOOD AND NUTRITION PUBLICATIONS.

Eight bulletins on subjects relating to the food and nutrition of man have been issued by this office during the past year.

Losses in Boiling Vegetables and the Composition and Digestibility of Potatoes and Eggs (Bulletin No. 43), by H. Snyder, Almah J. Frisby, and A. P. Bryant, contains an account of investigations carried on in cooperation with the University of Minnesota and elsewhere with special reference to the effects of cooking upon the nutritive value of potatoes, carrots, and cabbage, and the comparative digestibility of potatoes and eggs.

Report of Preliminary Investigations on the Metabolism of Nitrogen and Carbon in the Human Organism (Bulletin No. 44), by W. O. Atwater, C. D. Woods, and F. G. Benedict, contains an account of experiments with men in which the respiration calorimeter already referred to (p. 120) was used.

A Digest of Metabolism Experiments (Bulletin No. 45), by W. O. Atwater and C. F. Langworthy, involved in its preparation a considerable amount of work performed in connection with the nutrition investigations. An account of this bulletin is given on page 109.

Dietary Studies in New York City in 1895 and 1896 (Bulletin No. 46), by W. O. Atwater and C. D. Woods, contains a report on investigations of the food habits of a number of families in the congested districts of New York City. These inquiries were made in cooperation with the New York Association for the Improvement of the Condition of the Poor. The data reported in this bulletin throw much light on the nutritive value and cost of the diet of people living in the crowded sections of a great city as related to the other conditions of the life of people thus situated. This report has therefore attracted wide attention among those who are interested in the problems connected with life in great cities in our times.

Nutrition Investigations in Pittsburg, Pa., 1894-1896 (Bulletin No. 52), by Isabel Bevier, contains an account of investigations made in cooperation with the Pennsylvania College for Women and the Kingsley House, the college settlement of Pittsburg. The report includes six dietary studies, a study of the composition and cost of bread in Pittsburg, and a bakery experiment.

Nutrition Investigations at the University of Tennessee in 1896 and 1897 (Bulletin No. 53), by C. E. Wait, contains an account of the investigations carried on in cooperation with the University of Tennessee, in continuation of those reported in Bulletin No. 29 of this office. It includes studies of the composition of sides of beef and mutton and of the flesh of chickens, two dietary studies of a mechanic's family and two with students' clubs, and a number of experiments with man on the digestibility of various food materials and of a mixed diet.

Nutrition Investigations in New Mexico in 1897 (Bulletin No. 54), by Arthur Goss, contains a report on investigations made in cooperation with the New Mexico College of Agriculture and Mechanic Arts. The work reported in this bulletin is in continuation of that recorded in Bulletin No. 40 of this office, and consists of a study of



the composition of New Mexico beef and a dietary study of a Mexican laborer's family.

Milk as Food (Farmers' Bulletin No. 74) contains a considerable amount of information derived from the reports of nutrition investigations (see page 110).

#### IRRIGATION INVESTIGATIONS.

In the appropriation act for this Department for the current fiscal year \$10,000 was appropriated by Congress "for the purpose of collecting from agricultural colleges, agricultural experiment stations, and other sources, including the employment of practical agents, valuable information and data on the subject of irrigation and publishing the same in bulletin form." By order of the Secretary, supervision of the work on irrigation has been assigned to the director of this office. Prof. Elwood Mead, State engineer of Wyoming, who has had a long and successful career as a student and administrator of irrigation problems in the West, has been selected as consulting expert and chief assistant in planning and carrying on the irrigation work which this office has undertaken. Though the appropriation did not become available until July 1, 1898, much preliminary work was done prior to that date in making a general study of the problems of irrigation as related to agriculture in our country, in collecting the literature of irrigation, and in correspondence with experiment station officers, State engineers, and other experts, with a view to determining the field of work which the Department should attempt to occupy and the matters which first required our attention. In connection with its other work, this office has for a number of years been following up the literature of experimental inquiries in irrigation and has sought to aid and encourage the experiment stations in their efforts to carry on such inquiries. Special studies along this line have been made by Mr. W. H. Beal, of this office, who is thus in a position to aid materially in the new work in irrigation now undertaken by this office.

It was decided that the best way in which the office could get the advice which it needed for the formulation of plans of work along the most useful lines was to call a conference in the irrigated region of experiment station officers and irrigation engineers who had been most largely engaged in recent years in making experimental inquiries in irrigation or in dealing with the administrative and practical problems involved in the use of water for irrigation in the West.

This conference was held at Denver, July 12 and 13, 1898, and was attended by the following persons: Elwood Mead, State engineer, Cheyenne, Wyo.; E. W. Hilgard, director experiment station, Berkeley, Cal.; O. V. P. Stout, civil engineer, State University, Lincoln, Nebr.; L. G. Carpenter, irrigation engineer, experiment station, Fort Collins, Colo.; L. Foster, director experiment station, Logan, Utah; S. M. Emery, director experiment station, Bozeman, Mont.; E. S. Nettleton, formerly in charge of irrigation investigations conducted by this Department, Denver, Colo.; J. E. Fields, State engineer, Denver, Colo.; B. C. Buffum, agriculturist, experiment station, Laramie, Wyo.; D. Campbell, engineer, Denver, Colo.; G. L. Swendsen, irrigation engineer, experiment station, Logan, Utah. This office was represented by the director, who presided, and Mr. W. H. Beal. During the two days' session of the conference many of the problems of irrigation were earnestly and freely discussed and the needs of the farmer for information on irrigation subjects were carefully

considered. A stenographic report of the proceedings was prepared for the use of the office.

After careful consideration, it has been determined to confine the work of the office on irrigation for the present to two general lines: (1) The collation and publication of information regarding the laws and institutions of the irrigated region in their relation to agriculture, and (2) the publication of available information regarding the use of irrigation waters in agriculture, as determined by actual experience of farmers and experimental investigations, and the encouragement of further investigations in this line by the experiment stations. Arrangements have already been made for the preparation of several bulletins. The amount of money available for this work will not, however, permit the extension of financial aid to the experiment stations in any adequate way to justify their undertaking such complete and thorough investigations as the necessities of the case require. To be of any great value, these investigations should be planned on a comparatively large scale and in most cases must necessarily continue through a series of years. Every effort will be made to secure a wise and economical expenditure of the funds appropriated by Congress for the current fiscal year; but it should be clearly recognized that if the Department is to perform such service for the farmers in the irrigated region as their great needs and the vastness of the interests involved demand, there should be some settled policy established by Congress regarding the work of the Department in irrigation, and appropriations should be made from year to year in sufficient amount to enable the Department to organize and conduct satisfactory investigations for the benefit of the varied interests of the irrigated region.

While the practice of irrigation on a large scale is confined to the region west of the Mississippi River, there is growing interest in the subject in many localities in the more humid regions, where droughts often occur at critical periods in the growth of different crops. Useful investigations in irrigation have already been undertaken by the experiment stations in Wisconsin, New Jersey, and Connecticut. Much of this work is of such a character that the results have a direct bearing on the solution of the problems of irrigation wherever this method of applying water to crops is practiced. The work proposed by the Department should not, therefore, be considered as altogether for the benefit of any section of the United States. The settlement of irrigation problems is a matter of much importance to the general interests of the agriculture of this country.

West of the Mississippi River irrigation is practiced to a considerable extent in seventeen States and Territories. In a considerable number of these States the experiment stations are already carrying on useful investigations in irrigation and in the others they could easily extend their operations to include work in this line, provided an increase was made in their annual revenue which could be devoted to this purpose. It must be kept in mind that in most of these States the experiment stations receive only the income from the Hatch Act (\$15,000 per annum), and that they are working in the interests of an agriculture just in the beginning of its development and in States having great areas, comparatively sparse populations, and small revenue for public purposes. It can not be expected that they will be able to provide all that is needed to investigate a subject having such wide scope as irrigation. At the same time the problems connected with irrigation are so vitally connected with the life and material prosperity of the communities in which these stations are located

that not only the farmers, but also all the rest of the population, are deeply concerned in their right solution; and the postponement of the investigations will help to perpetuate a state of things which in many places has become well-nigh intolerable and to prolong the uncertainties which hinder the successful development of these regions as regards agriculture and other industries. In many of these communities the public controversies regarding the laws and institutions required to meet the needs of communities whose organized life is based very largely on the use of water for irrigation have reached a critical stage. By the collation of information and the prosecution of original investigations on irrigation the Department of Agriculture and the experiment stations, working together, may be of the greatest service to those communities within the next decade in reversing the wrong decisions of the past and marking out the right paths for the future progress of these great Commonwealths. There are also many interstate problems involved in the use of irrigation waters from streams running in more than one State with which the Federal courts and other authorities have to deal. The information on which the action of these officials should properly depend is now lacking. The investigations of the Department and the stations should furnish this information, and it would seem to be the duty of the National Government to provide adequate means for the conduct of such investigations as will relieve its administration of the interstate questions involved in irrigation practice of the burden of charges of unfairness and oppression growing out of the following of precedents which are inapplicable to an irrigated region and the rendering of decisions based on insufficient knowledge.

The following statements, taken from a recent communication of Professor Mead to this office, may serve to show some of the ways in which the Department may profitably work and the largeness of the interests and problems requiring its aid in the irrigated region:

The first purpose of this investigation is to aid farmers now living on irrigated land.

To do this it is proposed to collect and publish the available data relative to water rights, this to include the methods of acquirement, the control of streams and ditches by States and individuals, and a discussion and publication of the laws and methods of using and distributing water in the several arid States and in other countries. The need of this information and of a better understanding of our situation than the great mass of farmers now have is imperative. The diversion and control of streams have created a number of new and novel problems for which lawmakers, courts, or farmers have as yet no adequate solution. These are already assuming an importance which makes it manifest that the security of the irrigated home and the success of settlers on irrigated land are destined to depend largely upon their settlement. In irrigated regions values do not inhere in land, but in the water which fertilizes it. No amount of industry and skill on the part of a husbandman will bring a satisfactory return unless with it there goes effective and just control of the stream from which he and others draw their common supply. In this matter the individual is helpless. His success depends on his obtaining his proper share of the water supply, and this does not rest on his own efforts, but on proper administrative regulations. Our lack of knowledge of these facts and the comparative rapidity of our development have caused the use of water to outrun laws to govern its economical use or just disposition. As a result, irrigated farms are threatened with controversies and litigation which, if not averted, must prove disastrous. During the past ten years the litigation in Colorado over water rights has cost the farmers of the State over \$1,000,000. Six cases have gone to the Montana supreme court to decide what constitutes an appropriation of water, and it is still as much a subject of controversy as when the litigation began. The situation in these two States illustrates a general condition. Courts and lawmakers hesitate to deal decisively with these questions because they have not the requisite knowledge on which to base conclusive legislation. The Department of Agriculture can do the



West no greater service than to aid in putting the knowledge we already have in available form.

There is need of a systematic investigation to determine the volume of water used in the growth of crops, both to determine the requirements of different crops and of different climates and to determine the relation between the variations in the demands of crops and the fluctuations in the flow of streams. This information is needed as a basis for the proper division of streams by administrative officers. It is needed by canal builders in order to properly design these structures. It is needed by farmers to promote the saving of water, and thus limit losses through an inadequate supply or extend the acreage which can be cultivated. It is most seriously needed, however, to guide in the making of just and proper water-right decrees. In the disposal of streams courts can not now properly fix the volume to which appropriators are entitled. Until they know how much water irrigators use they can not decide how much they should receive.

These measurements should be made to show the utility of storage reservoirs and the part they can be made to perform in both saving the crops of farmers now along streams and making it possible for others to settle there. Without a definite knowledge of the variations which exist between the use of water in different months of the irrigation season and the fluctuation in the discharge of a stream, we can only conjecture as to the amount of flood water available for storage. A recent investigation of this question shows an almost entire absence of data on this subject. In only three States have there been any public determinations of the volume of water actually used in irrigation, and these have neither embraced the range nor been continued over a sufficient period to enable them to be regarded as conclusive.

In their efforts to promote reclamation the different States have pursued different methods. In some States corporations have been given almost unrestricted ownership of streams in order to secure the building of canals to divert their waters. In others the ditches are private property, but the water is under public control. In others irrigation works are being built by State or municipal appropriations, which are being paid for, or to be paid for by general or local taxation. All the facts in connection with these different methods ought to be collected and published.

The objects of the work which this office has undertaken regarding the laws and institutions of the irrigated region are: (1) To aid courts and administrative officers in the adjudication of claims respecting water rights; (2) to bring out the defects in existing laws and methods of administration, and to furnish impartial and adequate information on which wiser and more equitable legislation and court decisions may be based, and (3) to assist farmers in the acquirement of water rights and to protect their interests in the appropriation and use of water for irrigation. The collection of this information requires much painstaking search through a widely scattered literature and personal observations over a broad field. The preparation of the material for publication calls for much discrimination and an intimate acquaintance with the varied conditions prevailing in the vast region where irrigation is chiefly practiced. It will be no small task to make a clear presentation of the facts and principles involved in the legal and institutional aspects of the irrigation problems of the Great West, stripped of unnecessary technicalities and put in such shape as to form a correct and intelligible guide which may be relied upon as an authoritative summary of the data on which the development of the irrigation system should be founded.

The proposed investigation of the actual amounts of water used by successful farmers in different parts of the irrigated region on different soils and in the growing of different crops is a fundamental inquiry. It will furnish the basis not only for just court decisions and the equitable apportionment of water by administrative officers, but also for the more systematic and scientific inquiries with a view to the determination of the minimum amounts of water required for

successful agriculture under different conditions and the maximum area which can be properly irrigated in any given locality.

When the great variety of soil and climatic conditions existing in the Great West is considered, it will readily be understood that this phase of the irrigation inquiry must be extensive and far-reaching if the objects in view are to be attained. The measurements of the actual amounts of water used should be made in large numbers and for a series of years. It will be of comparatively little use to take up this work on a small scale. It should be planned and prosecuted in a manner which its importance demands; and this work should be begun at once and pushed rapidly to completion. Every year's delay in this undertaking makes the task of a proper settlement of the great water problems of the semiarid region more difficult and perplexing.

Among the investigations which this Department and the experiment stations should immediately undertake on a much more thorough and extensive plan than hitherto are those relating to the minimum amount of water required by different soils and crops, the best and most economical methods for the application of water to crops, the utilization of the rainfall as affecting the need for irrigation waters, the problems of seepage and drainage, the conservation of soil moisture, the effect of irrigation waters on the growth and productivity of plants of different kinds, the prevention of the accumulation of alkali in the surface soils, the reclamation of alkali lands, etc.

In view of the wide extent and variety of the work and the pressing need that it should be seriously and extensively undertaken without delay by the Department in cooperation with the experiment stations, I recommend that an appropriation of \$50,000 for irrigation investigations be asked for in the estimates for the ensuing fiscal year, and, inasmuch as the investigations should in large part be begun in the spring of the year and cover the period of the growth of crops, I deem it very desirable that half this amount be made immediately available.

## REPORT OF THE POMOLOGIST.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF POMOLOGY,  
*Washington, D. C., August 25, 1898.*

SIR: I have the honor to transmit herewith a report of the operations of the Division of Pomology for the fiscal year ending June 30, 1898, together with a brief outline of the work of the current year, and a statement of proposed plans and estimates recommended for the next fiscal year.

Respectfully,

G. B. BRACKETT,  
*Pomologist.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

The routine work which devolves upon the division continues heavy, and during the past year has consumed a large portion of the time and energy of the division force. As in former years, correspondence, including the investigation and reporting upon subjects submitted by persons interested in the production, shipping, marketing, or consumption of fruits, has occupied the most important place. The receipts of specimen fruits for examination and identification were about the same in number as during the previous fiscal year. During the year 485 descriptions were added to the files, more than 200 water-color paintings were made, and about 75 wax models were completed; a considerable number of photographic negatives of fruits and fruit trees and orchard scenes were also secured.

The accurate description and illustration of fruits by the various methods mentioned above involves a considerable expenditure of time by skilled employees, but in view of the current and future value and necessity of such forms of illustration in the classification and identification of varieties it is believed to be wisely and profitably expended.

### DISTRIBUTION OF TREES, SCIONS, CUTTINGS, PLANTS, AND SEEDS.

During the year about 200 lots of trees, scions, cuttings, plants, vines, and seeds of fruit-bearing varieties and species have been placed with experimenters in various portions of the country. The distribution included 185 varieties representing 26 species.



## COMPARISON OF METHODS OF ROOT GRAFTING.

The second year of the nursery period of the second comparative test of methods of root grafting the apple was completed. In this test 10 varieties selected as representative of the principal commercial apple districts were included, the details of the experiment being, in the main, identical with those recorded in the report of 1897 (p. 149).

In the spring of 1898, after the trees had been measured and graded alternate ones were taken up from the nursery rows and gathered into sets of varieties, which were placed with experiment stations and individuals in Indiana, Maine, Maryland, Massachusetts, Missouri, and Nebraska for planting in orchards. The remainder of the trees will be held in the nursery until the end of the growing season of 1898, when they will be similarly treated. A detailed account of the experiment will be published hereafter.

## CARD CATALOGUE OF FRUIT VARIETIES.

The preparation of the descriptive catalogue of the fruit varieties that have been described in the standard pomological works published in the United States has been continued by Mr. T. T. Lyon, of Michigan, the special agent of the division. During the year the catalogue of pears has been completed. It contains cards for more than 1,500 varieties and more than 3,700 synonyms. Mr. Lyon is now engaged upon the catalogue of peaches. Certain changes have been made in the original plan after due consideration and experience in the work, which, though increasing the labor of preparation, will add greatly to the value and accuracy of the catalogue when completed.

## EXHIBIT AT THE TRANS-MISSISSIPPI INTERNATIONAL EXPOSITION AT OMAHA.

The exhibit of fruit models made by the division at Omaha was planned with the view of furnishing information to observant visitors in regard to the appearance and varietal characteristics of important fruits. One group illustrated the principal commercial varieties of apple grown in the trans-Mississippi region; another the varieties of apple adapted to dessert and home use in the same region, while a third was composed of Russian varieties and crabs. Still another group contained specimens of new and little-known varieties of the apple from various portions of the United States. A miscellaneous collection contained specimens of the leading commercial and dessert fruits of the United States.

A large collection of water-color paintings, photographs, and descriptive sheets illustrating the methods of fruit description practiced in the Division of Pomology was shown.

A special feature of the exhibit was a collection of sun-dried and evaporated fruits of the United States, illustrating the commercial grading and packing of such fruits for market.

This collection contained about 200 specimen packages and 32 commercial packages.

## VARIETAL HERBARIUM.

The services of a skilled mounter of plants having been secured, more than 1,300 herbarium specimens of fruit varieties have been mounted during the year and stored in suitable cases, where they are

convenient of access. This collection adds materially to the equipment of the division in identifying and classifying varieties.

#### MAPS OF FRUIT DISTRICTS.

Late in the year a beginning was made in the mapping of fruit districts, provisional maps of the country showing the principal areas of production of apples, peaches, prunes, raisin grapes, oranges, lemons, almonds, walnuts, and cocoanuts having been prepared.

#### ADDRESSES AND PUBLICATIONS.

During the year addresses were delivered by the Pomologist or the Assistant Pomologist at the meeting of the American Pomological Society at Columbus, Ohio, and at meetings of the State and district horticultural societies in New Jersey, Maryland, and Virginia.

By a cooperative arrangement made during the incumbency of my predecessor, Prof. S. B. Heiges, an edition of 15,000 copies of the "Catalogue of fruits of the American Pomological Society" was published as Bulletin No. 6 of this division. The catalogue was revised by a committee of the society of which Mr. T. T. Lyon, of Michigan, was chairman. The demand for this bulletin was so great that the issue of a second edition of 2,000 copies became necessary within a few weeks after it appeared.

This catalogue, which was first published by the society in 1852 and has been revised from time to time for distribution among its members, has long been recognized as the standard authority upon pomological nomenclature and the most comprehensive guide to the adaptability of varieties and their relative value for planting in those fruit-growing portions of the country where they have been tested and reported on by fruit growers.

From the nature of the case this catalogue will need to be occasionally revised, as longer experience and fuller information make changes necessary. Covering the entire country as it does, it can hardly be expected that it will ever reach that state of accuracy and exactness which would make it a guide to be blindly followed by an inexperienced planter, but it is believed that it will become a most valuable index to the fruit industries of the country as well as an efficient agent in the simplification and standardizing of fruit nomenclature. Recognizing the fact that many changes in the catalogue were necessary and that they should be promptly made, the division and the society, through a committee, have already entered upon a cooperative revision, which it is hoped will be ready for publication during the present fiscal year. In this revised edition it is expected that the adaptability of varieties to the newer fruit districts, particularly those of the Rocky Mountain and Pacific coast States, will be more fully set forth than in former editions of the catalogue.

An edition of 10,000 copies of a bulletin entitled "The fruit industry," prepared by the Assistant Pomologist, was published as Bulletin No. 7 of the division series. Part of the matter contained in it had previously appeared in the form of an article in the Yearbook of the Department for 1897, but the subject was regarded as of sufficient importance to justify its publication in bulletin form, especially as the number of copies of the Yearbook at the disposal of the Department is limited. A third edition of 1,000 copies of the "Report on nut culture" was published during the year.

## SUNDRY INVESTIGATIONS DURING THE YEAR.

In recognition of the lack of definite knowledge concerning the fruit districts of the Pacific slope a special investigation of that subject was made, the results of which will be included in the next revision of the fruit catalogue, which it is expected will be published during the coming fiscal year. For this purpose, Prof. E. J. Wickson, of the University of California, was appointed as special agent of the division for a period of six months. Prof. W. H. Ragan, of Greencastle, Ind., who is chairman of committee on revision of catalogue of the American Pomological Society, and whose work upon that catalogue consumes a large portion of his time, was made a special agent of the division for the term of three months in recognition of the cooperative work undertaken by this division with the society in the revision of this catalogue.

## CURRENT WORK.

The nursery period of the second comparative test of methods of root grafting the apple, which, for various reasons was continued one season longer than was originally intended, will be completed during the year.

The systematic collection and mounting of material for the varietal herbarium which was begun late in the last fiscal year will be continued. Through the kindness of Mr. J. W. Kerr, of Denton, Md., herbarium specimens of 243 named varieties of native plum have been added to the collection. Comprehensive collections of varieties of other fruits will be made whenever opportunities to secure them arise, while the receipts of specimens of single varieties by mail from time to time are carefully preserved and recorded.

The state of war existing between Spain and this country has prevented further negotiation for authentic stock of Jordan almond, but it is expected that in the near future such will be secured.

In cooperation with the newly established Section of Seed and Plant Introduction an investigation of the present status of the cultivation of the European grape in the southeastern portions of the United States is being made with a view to determining whether renewed efforts in the introduction and cultivation of varieties of *Vitis vinifera* on resistant stocks in that region can be profitably undertaken.

Such preparatory work for the exhibit at the Paris Exposition in 1900 as can be done with the limited force and appropriation at the command of the Division of Pomology will be undertaken. The lack of sufficient available appropriation has prevented the attempt at furnishing experiment stations and agricultural colleges with duplicate sets of models of fruits in the manner proposed in the reports of 1896 and 1897. Such sets are desired by the horticulturists of many stations and colleges, and would undoubtedly be valuable additions to their equipment.

By cooperation with the Section of Seed and Plant Introduction, it is expected that many of the promising fruit-bearing species of foreign lands referred to in the report of last year will be speedily introduced for experimental cultivation in this country.

The limited appropriation available for field work continues to prevent several important lines of pomological investigation that could profitably be made.



**PLANS FOR THE ENSUING YEAR.**

The lines of investigation already undertaken are being conducted under decided disadvantage for lack of sufficient clerical and expert force, and there is therefore urgent need for larger appropriations for the work of this division.

In addition to the several subjects under investigation, work upon which will be continued, it is desired that during the next fiscal year a symmetrical and comprehensive representation worthy of the importance of the fruit industry of the United States shall be completed for exhibition at the Paris Exposition in 1900. It is believed that in the present state of our fruit industry great benefit to producers and shippers would result from a correct understanding of our pomological resources and a proper appreciation of our pomological products by the fruit-consuming millions of Europe. It is regretted that funds for the preparation of a suitable exhibit are not already available, as the limitation of the preparatory work to a single year necessarily narrows the scope and endangers the symmetry of an exhibit which from its character is dependent upon the seasonal vicissitudes of climate. Though the preparation of a suitable exhibit will involve a considerable interruption in the work of the division, it is believed, in view of the approaching possibility of overproduction of certain of our fruits, that it will greatly benefit the fruit industry as a whole by correcting popular misapprehension abroad and widening the foreign demand for American fruits and fruit products.

The recent and prospective increase in our fruit-producing areas through the acquisition of islands possessing the various gradations of tropical and subtropical climate makes necessary the prompt extension of pomological field investigation to such territory. The development of the dormant pomological resources of those islands will undoubtedly be undertaken promptly by private enterprise and capital, most of which will be drawn from the continental territory of the United States. Active work along these lines is, in fact, already under way. Such development will undoubtedly affect several of the important fruit industries already established within our borders, especially those of our own Gulf States, Arizona, and California. So long as the dissemination of information concerning the probabilities of fruit production in these little-known island regions is left to private parties interested in encouraging migration thither there will be uncertainty and unrest among fruit growers at home, which will hamper domestic development and unfavorably affect the value of investments in fruit lands in our subtropical districts. These investments amount at the present time to many millions of dollars. In addition to this the exaggeration of the prospective profits of fruit culture by persons interested in the sale of lands upon these islands is likely to result in disappointment and financial loss to many of our citizens. It is therefore deemed important that a thorough investigation of the pomological resources of the Hawaiian Islands and Puerto Rico be undertaken by this division at the earliest possible opportunity and that the results be promptly published for the information of our citizens, who are vitally and financially interested both as producers and consumers in the prospective fruit production of these islands.



## REPORT OF THE CHIEF OF THE DIVISION OF SOILS.

U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF SOILS,  
*Washington, D. C., August 17, 1898.*

SIR: I have the honor to transmit herewith a report upon the work of the Division of Soils for the fiscal year ending June 30, 1898.

Respectfully,

MILTON WHITNEY,  
*Chief.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

#### PRINCIPAL LINES OF WORK.

The work of the year has been a continuation and an extension of the work of previous years, as outlined in the Yearbook of the Department for 1897. It consists of the classification of soils through an examination in the field and laboratory; of the accurate mapping of these soil areas; an investigation of the physical and other properties of soils, to determine the relation of the soils to crops; the origination and investigation of methods for the examination of the soils and soil conditions; of the collection of soil moisture records as a feature of the climatology of agricultural districts; a study of alkali soils and irrigation; the investigation of unfavorable conditions in soils where crops are injured or entirely lost; effect of cultivation and fertilization upon the physical conditions of the soil; tobacco investigations; the clerical work incident to the field and laboratory investigations, together with the ordinary correspondence of the division.

#### THE CLASSIFICATION OF SOILS.

During the year three field expeditions were sent out, resulting in the collection of a large amount of material and information in regard to some of the important soil formations of this country. The first of these was a reconnaissance through the Northwestern States from Minnesota to Washington, through the great valley of California and southern California, and through Nebraska and Utah. Some of the observations made on this trip were published in the Yearbook for 1897, in a short article entitled "Some interesting soil problems." A second expedition went to Florida and secured material for the completion of a preliminary report upon the soils of Florida, published as Bulletin No. 13 of this division. A third expedition was sent to Montana to make an investigation of the conditions in the alkali soils of the Yellowstone Valley. Much valuable data were secured from this trip



and the results are being prepared for publication. In addition to this, samples of typical soils have been received from reliable sources in Argentina (wheat lands), Bermuda (lily soils), Hawaii (types), Mexico (tobacco and coffee), and Russia.

Five hundred and fifty-nine samples of soil have been collected during the year from different parts of the United States and from abroad, and 325 mechanical analyses have been made. The soil collection of the division amounts now to over 3,800 samples, all very fully described and carefully preserved and classified.

#### MAPPING OF SOIL AREAS.

In previous reports recommendations have been made that the appropriation for the division be increased so that reliable maps of some of the important agricultural districts could be made. Detailed field work of this kind is quite expensive, as it requires so much time for the detailed examinations of the soils of a district. It is necessary to have a party of two or three persons in the field for five or six months to accurately map the soils of an area of about 2,000 square miles. It has not been possible with the means at our disposal to do much systematical work of this kind, but some small areas have been mapped, and arrangements have been made for cooperative work with one of the State geological surveys, whereby it is expected that a considerable amount of this work can be done during the coming year. The importance and necessity of this work will be more fully set forth in speaking of the tobacco investigations. A collection of over 1,200 topographic, geologic, and soil maps have been secured from this country and from abroad as a basis for this work. These are being classified and catalogued, so as to be readily accessible and available.

#### PHYSICAL PROPERTIES OF SOILS.

Investigations are in progress of the principles governing the actual movement of water in soils in the field and of a method of determining the extent and rapidity of this movement where any disturbing factors are present, such as the evaporation from the surface or the transpiration by plants. This is one of the essential points in the relation of soils to crop production, that is, the rapidity with which a volume of water can be delivered at a certain point to supply loss through evaporation. There is reason to hope that methods can be devised for determining these conditions.

Mr. Lyman J. Briggs, physicist of the division, has published during the year an important bulletin on "The mechanics of soil moisture," treating particularly of the cause of the movement of water in soils. This matter has never before been clearly understood. He shows that what is commonly known as the capillary movement in soils is due entirely to the form and curvature of the water surface existing in the capillary spaces between the soil grains. He contributes an article on this for the current number of the Yearbook of the Department. This work has done much to enlighten us about the relation of soils to moisture and to explain some of the apparently anomalous conditions which have been found to exist in soils.

Other important investigations are being carried on in soil physics, the most important probably being an investigation of the forces acting between the minute grains, constituting the soil itself, and

influencing the distribution of the soil grains. This is of the highest importance in the study of the deterioration of soils through the change in their physical texture, a matter which comes up so often in inquiries from farmers and horticulturists to know what can be done to restore the fertility of these soils which has been lowered by long continued cultivation.

#### METHODS AND INSTRUMENTS.

Considerable time has been given, as heretofore, to the study of methods and the devising of instruments for the study and recording of the physical properties of the soils in the field. Much of this work is still in a tentative state in which no positive statement can be made at this time.

A very convenient and simple modification of the electrical instrument for determining the moisture content of soils has been devised. This has a direct reading scale applicable to all soils, and indicates directly, from the position of the pointer, the condition of the soil moisture as compared with the normal water-holding content of the soil. This involves, therefore, no calculations or reductions, as is the case with the present form of instrument. Another important consideration is that these instruments will cost very much less than the present form, and it is probable that they can be made and sold for from \$6 to \$10 apiece. Each instrument can be used for a number of plots or different fields. This instrument is well adapted to greenhouse work. It is being thoroughly tested now in one of the large commercial houses near Washington, D. C., and the results so far obtained indicate that it will have a place in commercial greenhouse work on a par with the thermometer.

The electrical method of determining the soluble salt content of soils in the field has been much simplified and adapted to rapid investigations and the underground survey of alkali lands. This will be referred to more at length elsewhere.

#### SOIL-MOISTURE RECORDS AND CLIMATOLOGY.

The electrical method of determining the moisture in the soil of the field, described in Bulletins Nos. 6 and 12 of this division, has given great satisfaction in the hands of the observers of the division. Thirty-one stations have been equipped with these instruments during the present crop season, and records have been taken from 148 different electrodes showing the daily fluctuations in the water content in different types of soils under different methods of cultivation and with different crops.

These stations are located in 16 of the States, fairly well distributed over the country. Nineteen of the electrodes have been in typical wheat soils, 10 in corn lands, 7 in grass lands, 5 in tobacco lands, and the remainder under such crops as oats, barley, potatoes, and cabbage.

The average cost of the equipment of one of these stations, with a measuring-box and electrodes for the study of moisture conditions under four different crops or in four different fields and including a rain gauge, is about \$40. This will probably be considerably reduced with the modified form of instrument. The observations are taken once each day during the growing season of the crops, which averages about four months in each locality.

In order to standardize these electrodes and in order to have a thorough check upon the method itself, about 1,700 samples of soil have

been collected by the observers during the year, under instructions by this division, and sent in air-tight cans. Duplicate moisture determinations have been made in the samples. A very satisfactory agreement has been shown in this way between the amount of moisture indicated by the instruments and that actually found by moisture determinations.

In most cases, and wherever possible, the equipment of these stations has been installed by an officer of this division. In nearly all cases the instruments have been put into the hands of farmers who have faithfully and intelligently carried out the directions and have accumulated a large amount of very valuable data.

In a very few cases it was not possible to send officers of the division, and the instruments have been installed by the farmers themselves, under instructions from this division. It is believed that by another season the method will have been so far simplified and the instructions will be so simple and plain that the apparatus can be installed without trouble by any intelligent farmer.

Several of the instruments have been loaned to some of the experiment stations, and although these have been accompanied with very plain and explicit directions for their installation, the same as prepared for the observers of this division, the records obtained from the stations have not as a rule been satisfactory. Considerable time has been devoted to this, as it is very desirable that the process be introduced into the experiment stations, as it will prove a valuable method for their use in research work. Considerable expense also has been incurred in several cases to send an assistant from this division to investigate the cause of the trouble reported. It is difficult to say just what the trouble has been due to, but in some cases at least it has been owing to lack of attention to the instructions sent for the installation and reading of the instruments, probably through lack of time on the part of the station officials.

Mr. Frank D. Gardner, in charge of these moisture investigations, published the results of the moisture observations during the crop season of 1897 in Bulletin No. 12 of this division. The records of the present season up to June 30 have not been fully worked out, but enough is known of them to show that much additional information is being obtained regarding the relations of the soils to moisture and the dependence of the crop production upon the moisture content of the soil.

Among other valuable features, these observations are establishing the normal water-holding capacity of a number of important types of soils under prevailing climatic conditions, the extent and rapidity with which rainfall or irrigation waters are supplied to the crop or are lost by evaporation or sink down through the subsoil and drain away. This shows the capacity of the soils for retaining moisture during the periods of drought. The observations are also establishing the lines of drought and of excess of moisture for different soils and for different crops, the best amount of water for the preparation of the land and the cultivation of the crop, for the germination of the seed, the growth of the vegetative parts of the plant, and the maturity of the seed or fruit. They are also throwing additional light upon the possible extent of the control of the moisture conditions through methods of cultivation and fertilization.

This work is gradually leading up to a more thorough knowledge of the greatest of all factors limiting the production of agricultural



products, drought, and to a study of the conditions of cultivation or of treatment for the amelioration of the effect of drought on the soil.

In my last annual report I called attention to the *relation* of the soil moisture, the temperature, relative humidity, and wind velocity of the atmosphere in the growth of plants. Since then the possibility of establishing an exact relation of these factors has been carefully considered. It has been possible to determine, approximately, the numerical value of per cents of soil moisture as equal to units of temperature, humidity, and wind velocity. This makes it possible to express numerically the relative conditions of plant growth in terms of the normal. It may be stated, for example, that the atmospheric conditions are 95 per cent of the normal, and the conditions of soil moisture are 105 per cent. As the unit in each has the same value, the average conditions would be 100. These values are merely tentative at present, but they form a basis for further investigations, which are being rapidly developed.

The conditions of plant growth may be classed under three heads, namely: (1) The conditions influencing evaporation or loss of water by the plant (these depend upon the temperature, the relative humidity, and the wind velocity); (2) upon the water supply maintained by the soil; and, (3) the intensity of the actinic and heat radiations which influence the physiological activities of the plant.

It will be seen that evaporation is a summation of the temperature, relative humidity, and wind movement, and these separate observations can be neglected if we have a reliable method of determining the evaporation from day to day. This furthermore very greatly simplifies the calculations and the determining of the equivalents of units of temperature, humidity, and wind velocity. This work is closely related to the work of the Weather Bureau, but as neither the records of evaporation nor soil moisture determinations are made by the Weather Bureau, it constitutes a new field of work to be developed. Frequent consultations have been held between the chief of this division and the chief of the Weather Bureau in order that the most perfect harmony could be secured in the development of the research. In the further development of the method it will be necessary to have the help of a well-trained plant physiologist, but this will be secured through the hearty cooperation of the Division of Vegetable Physiology and Pathology. In the application of the method it will be necessary to cooperate closely with the Division of Statistics in order to define accurately the principal crop areas and to collect the information through the points of greatest value to the agricultural interests of the country. The necessary cooperation has been cordially promised by the chief of the Division of Statistics.

#### ALKALI SOILS AND IRRIGATION.

Investigations of the soluble salt content of soils and the concentration of the soil moisture through the electrical method have been continued. The method has been somewhat modified to adapt it readily to extensive and rapid field examinations. The method consists simply of determining the specific resistance of the soil in a saturated condition in an electrolytic cell. A correction is made for the obstruction offered to the passage of the current by the undissolved particles of the soil. This correction is easily determined, and is used as a constant for a whole series of observations. The specific resistance of the soil solution is thus obtained, and from this the percentage of soluble

matter per unit volume of solution or per unit weight of soil can be readily estimated.

Mr. Thomas H. Means has developed this method. During the year Mr. Means made a careful study of the alkali soils of the Yellowstone Valley around Billings, Mont. An examination was first made of the general conditions in the valley, and then a very minute study of a section of land which was just being ruined by the rise of alkali. This examination amounted to an underground survey of the field, and maps have been made showing the distribution of alkali at different depths. A great number of borings were made to a depth of 10 or 15 feet, and salt determinations were made in every 6 inches or each foot in depth. Accurate maps have been made showing the amount and distribution of the alkali at several of these depths.

The result of this investigation will be issued in the form of a bulletin. Briefly, it was found that in the original prairie soil above the ditch there is not sufficient alkali to be injurious to vegetation. The amount of alkali was greater in the lower depths of the subsoil. As a rule, water is used in excess on all of these lands under irrigation, and to such an extent that it accumulates in the subsoil. When the depth to standing water is not more than 2 feet from the surface alfalfa turns yellow and dies out. In all cases the first injury was from the accumulation of water from excessive applications through irrigation. Where this water remains for sometime in the subsoil the alkali leaches down through seepage from higher lands, and is brought up from the subsoil and accumulates at the surface in quantities sufficient to prevent the growth of cultivated plants. Other problems of great value to the agriculturist were worked out in the course of this investigation. Such work will be invaluable in the treatment of alkali soils.

Much interesting information has been thrown upon the constitution and properties of soils through the use of this electrical method of moisture determination, particularly by investigations made in the laboratory. It has been clearly shown, for example, that an increase in the temperature of the soil moisture increases the amount of salts which go into solution, and, conversely, as the temperature falls the salts go out of solution and are deposited upon the surface of the soil grains. The amount of salts dissolved from a soil varies with the amount of moisture as well as with the continuous action of the solvent. Repeated drying of the soil and wetting it up again greatly increases the percentage of soluble matter as well as the heating or burning of the soil. The soil grains have the power of attracting salts to their surface and holding them there with a physical attraction which prevents leaching, but which at the same time continues the physical properties of the salt in solution adjacent to the surface of the grains. In the examination of the subsoils from a number of localities in Florida, where the die-back disease of the orange occurs, it has been found that there is an acid product closely adhering to the grains of sand which is soluble, as shown by its action on test papers, but which is nonleachable, as indicated by the fact that the water a short distance away from the surface of the grains show little or no acid reaction.

#### TOBACCO INVESTIGATIONS.

This division has been engaged for a number of years in the investigation of the tobacco soils of the United States. Gradually the whole subject of tobacco culture and curing has been assigned to the division.

This has involved a considerable amount of correspondence, the preparation of reports and papers, and the consideration of methods of cultivation and of fermentation for the best and most economic production, and a consideration of domestic and foreign competition. Naturally, much thought has been given to the subject of the true work of the Department for the tobacco farmer.

Requests have come in from all over the country for the establishment of experimental or model tobacco farms and to send instructors through different sections of the country to train people as to the methods of cultivation and curing. The reply to such requests has always been that the Government provides for these local questions through the experiment stations located in each State. Several of these, notably the Massachusetts, Connecticut, Pennsylvania, Maryland, Virginia, Kentucky, North Carolina, and Florida stations, have done considerable to advance the interest of tobacco culture within their States. The development of purely local questions may safely be left to the State experiment station.

There is, however, a larger sphere for the General Government which the State experiment stations can not enter.

The tobacco business has become very highly specialized. Each market has its own requirements; each class of users have their own particular style, and each season brings some change of style which must be met by the tobacco grower. There is a great deal of competition in our own country, and very serious competition from abroad, especially from Cuba and Sumatra. In several of our tobacco districts the acreage has been reduced one-half in the past ten or fifteen years. Some of the districts have almost completely abandoned the culture of tobacco. On the other hand, several new localities are being opened with prospects of good prices for good grades of wrapper-leaf both for cigar and manufacturing purposes. The best we can do, however, in the cigar leaf is far below the product of foreign countries. The Cuban filler sells for ten times as much as the Pennsylvania and Ohio filler; the Sumatra wrapper is worth ten or fifteen times as much in the markets as the Connecticut wrapper. To meet this competition it is absolutely necessary that our farmers should have at their disposal a thorough knowledge of their own conditions and of the conditions of the soil, climate, methods, and labor conditions of competing districts.

*Soil maps of the tobacco districts.*—One of the first necessities in the development of a new district or in the improvement of an established district is an accurate soil map of the locality on which the soils adapted to the different types and grades of tobacco are plainly shown. In all of our tobacco districts there are large areas of land cultivated in tobacco which are not adapted to a good grade of tobacco. There are also large areas well adapted to a fine grade of leaf which have never been used for this purpose. Enough is known of the relation of soils to tobacco to warrant the preparation of very accurate maps, indicating the character of the tobacco from each of the soil areas in the district. After these types have been established and the soil areas have been mapped, the experiment station can take up a study of the cultural methods adapted to each of the types of soil. In this study of the influence of the soil upon the quality of the leaf, it is important to extend the study to all localities and to gather information from Cuba and Sumatra as well as from Kentucky, Virginia, Pennsylvania, and Connecticut. This is work that the experiment stations can not do for themselves.



*Curing and fermentation.*—Among the most important lines of work which the Department can take up for the tobacco grower is the study of the diseases in the tobacco bed and the comparatively few diseases in the field, and particularly the study of curing and fermentation. A large amount of research work has been done, particularly in Germany, in the fermentation of tobacco, but very little is yet known of the changes which go on in the process or about the specific agents which bring about these changes. So much information and practical benefit have been derived from a study of butter and cheese in the control of the ferments and bacteria, which produce the texture and flavor of the product, that it is very desirable that similar knowledge in the curing and fermentation of tobacco and similar control of the finished product should be secured. This work will require very careful study in the changes in the fermenting pile in the different tobacco districts. It is important to know exactly to what organisms the peculiar flavor and aroma of the tobacco is due, what influence is exerted by the character of the leaf, by climatic conditions, and by methods of manipulation. This work can only be thoroughly done by systematic working in different tobacco districts in our country with different varieties of tobacco and under different climatic conditions. It should certainly embrace a study of fermentation in the tobacco districts of Cuba and of Sumatra. If our tobacco growers are to attempt to raise a product equal to that of Cuba and Sumatra, and if this is to be done not by chance but through systematic scientific investigations, then the soils and other conditions of growth must be thoroughly understood and the fermentation changes carefully worked out in Cuba and Sumatra. It is necessary, therefore, that a soil expert and a bacteriologist extend their work to these foreign countries.

*Breeding and hybridization.*—If it is found that our soils and climatic conditions are not adapted to the very best types of tobacco, and that sufficient control of the product can not be obtained through methods of fermentation, it may be possible to introduce a new variety of tobacco or originate a variety through scientific breeding and hybridization which will give the finished product desired under given conditions of soil and climate. The possibilities of imparting any desirable character to the texture of the leaf and to the fragrance and taste of the cigar, through systematic breeding and hybridization, is hardly even remotely understood. The possibilities of adapting the crop to existing conditions in this way are, however, certainly very great. These two lines of the study of the changes of fermentation of tobacco and the improvement of the stock through breeding and hybridization belong, of course, to the Division of Vegetable Physiology and Pathology, but the acting chief of that division has promised his hearty cooperation in the matter.

In view of the great importance of the tobacco industry in this country and of the very great results which are likely to be accrued from the investigation of the subjects herewith presented, I will present in connection with this report an estimate of \$12,000 for tobacco investigations.

#### MISCELLANEOUS AND CLERICAL WORK.

Numerous applications come in for information in regard to methods of reclaiming or improving lands or of adapting them to particular crops. Where these requests come from individuals and are of merely

local interest and require any amount of investigation, the requests are usually referred to the experiment station in the State from which they originate. This seems to be the best policy. It tends to relieve the division of an immense amount of local and routine work, and it gives the experiment station, which has been established for the study of just such local problems, the prior right to the field and the advantage of learning of the needs of particular sections of the State. Where the stations are not equipped for this work, or where for other reasons they have requested cooperation, it has always been cheerfully accorded, as far as it has been possible.

Considerable attention has been given to work sent in from other divisions and from other Departments of the Government. Soil samples have been examined for the Divisions of Chemistry, Vegetable Physiology and Pathology, Botany, the United States Geological Survey, and at the request of several Senators and Representatives.

The correspondence of the division has increased 50 per cent over last year. Considerable other miscellaneous work has been done in the division, including the preparation of bulletins, reports, papers, maps, and the proof reading of the same; the calculation and tabulation of the records from the soil observers, and the cataloguing of books, reports, and soil samples. The library of the division contains now something over 1,000 volumes relating to soils and closely allied subjects. All of these have been catalogued and classified during the year.

#### RECOMMENDATIONS.

First. I again respectfully renew my recommendation of former reports, that the preparation of accurate soil maps be undertaken. It will be of immense practical value to the agriculturist and horticulturist to have reliable maps of the soils of the principal agricultural regions of the country.

Second. I recommend very strongly that the tobacco investigations, outlined in a preceding paragraph, be taken up and pushed to a speedy conclusion. The tobacco interests of this country are very large and the competition among our own growers and from abroad is becoming greater all the time. It is necessary that our own growers should have all the information possible to enable them to compete successfully and to meet the increased specialization of the market demands. Several of the State and county tobacco growers' associations have sent in resolutions during the year urging the Secretary to map the soil areas; to investigate the soils and other conditions in Cuba, Sumatra, and other competing countries; to investigate the changes which go on in the curing, and especially in the fermentation, of tobacco, and to investigate the diseases of the plant.

Third. For the fullest development of the work of the division and in the study of the physical properties of soils in their relation to water and to crop distribution it is very important that we have at our disposal a small plot of land near the division for testing instruments and methods under our immediate supervision. A plot of 100 feet square would be sufficient for the present. The Department grounds are already so filled up that it is, I am aware, very difficult to arrange for this, but possibly some of the work already in the grounds could be removed to some suburban place without serious detriment.

Fourth. It is also quite necessary that this division have the use of

a well-equipped greenhouse especially constructed for soil investigations. Temporary arrangements can probably be made to start work of this kind on a small scale in one of the already over-crowded greenhouses in the Department grounds, but it will be impossible to carry on the investigations in a way at all commensurate with the importance of the subject without a fair-sized building especially arranged and devoted to this work.

Fifth. In the acquisition of recent colonial possessions by the United States it will unquestionably be necessary in time to extend the work of the Department of Agriculture into tropical countries where the conditions are altogether different from those in this country. It will be necessary that the investigations of the Department be extended to these countries, both for the benefit of our new possessions and for the information and benefit of our own people. I earnestly recommend that with the adoption of any policy in regard to these colonial possessions by the Department of Agriculture the claims of this division be recognized, and that the work of the division be extended so that the soil investigations shall form a part of any plans for the extension of the work of the Department of Agriculture.



## REPORT OF SUPERINTENDENT OF EXPERIMENTAL GARDENS AND GROUNDS.

U. S. DEPARTMENT OF AGRICULTURE,  
EXPERIMENTAL GARDENS AND GROUNDS,  
*Washington, D. C., August 15, 1898.*

SIR: I have the honor to submit a report of the work in the Experimental Gardens and Grounds for the fiscal year ending June 30, 1898.  
Respectfully,

WILLIAM SAUNDERS,  
*Superintendent.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

#### DISTRIBUTION OF SEEDS AND BULBS.

The distribution from this division during the fiscal year included 66,260 strawberry plants, 25,500 grape plants, 1,800 olive plants, 3,900 fig cuttings, 820 camphor trees, 580 guava plants, 150 pineapple plants, 50 vanilla plants, 40 cinnamon plants, and 1,529 miscellaneous, consisting in part of pepper, citrus, loquats, palms, and 99,850 bulbs of various kinds.

#### GROUNDS AND PLANT HOUSES.

The proper care of the grounds and plant houses has been duly attended to. A portion of the asphalt roads has been thoroughly resurfaced, and the roofs of several of the glass houses and frames have been removed, the woodwork overhauled, then reglazed and painted in a thorough manner, so that they are nearly as tight and as good as new.

There are still many thousand yards of asphalt roadways and paths that are in need of resurfacing. These have been repaired from time to time during the past fifteen or more years—an expedient both costly and unsatisfactory.

#### PLANTS AND SEEDS.

The propagation of plants for general distribution has been prosecuted as far as time and means have allowed, resulting in many thousands of plants of various kinds, among which over 6,000 camphor trees will be available.

The testing of newly introduced varieties of plants and seeds, although at one time a prominent feature in the work of this division, has been for some time almost abandoned. Among other reasons, it

was found, in the case of seeds, the result from the growth of one season in one place and climate was not sufficient test to base a value or factor for the further extension of the variety; that it was of local significance only, and could not be utilized as a guide to the value of the plant in other districts and under different conditions.

After the formation of State experiment stations it was conceded that they offered the best available conditions for testing the merits of all kinds, as in one season reports could be secured which would embrace the results from widely extended districts, and thus furnish data which would be of value for the further distribution of varieties.

#### INTRODUCTION OF NEW PLANTS.

While the introduction of new plants is a function of the Department, yet discretion has to be exercised as to their possible value to the country, that is, their promise of commercial importance, and not of their novelty as merely ornamental plants, requiring hothouses and conservatories for their safe-keeping.

Strictly tropical plants can not be grown with satisfaction in any portion of the United States, although some do succeed fairly well in limited areas. Much depends upon conditions existing in their native localities; those from the higher altitudes even in the tropics may be fitted to grow throughout the warmer regions of this country, so that, in the absence of information relating to the native habitats of the plants, their climatic requirements can only be ascertained by experiment.

There are some plants which yield products of considerable value which have been subjects of climatic experiment to a certain extent, mainly in the belief that these products were being exhausted in native regions, a belief now known to be without foundation in fact. The cinchona, or Peruvian bark tree, is a case in point. Fifty years ago, on account of the careless manner of collecting and the annual destruction of these forests in Peru, the British Government transplanted seedling trees into various of her tropical colonies, with the result that the supply from Asiatic sources is now beyond the demand; so that plantations formed in the West Indies have been abandoned as utterly unprofitable, not being able to compete with the cheap labor in the East Indies.

Again, the introduction of the rubber plant in southern Florida is attracting considerable attention, based upon the supposition that the climate is suited to the growth of the plants and that the native trees in the Amazonian regions are becoming extinct; both of these suppositions are erroneous. There is no part of Florida where success may be expected in growing these tropical trees, and there is no immediate danger of the supply of Para rubber becoming exhausted. A recent consular report says that the supply is inexhaustible, because the trees are continually being reproduced. Some districts are becoming temporarily exhausted after tapping the trees for forty years, but many districts have not been tapped. The area that is known to produce Para rubber amounts to at least 1,000,000 square miles, and further exploration will, no doubt, show that this area is underestimated.

## REPORT OF THE AGROSTOLOGIST.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF AGROSTOLOGY,  
*Washington, D. C., August 29, 1898.*

SIR: I have the honor to submit the fourth annual report upon the work of the Division of Agrostology for the fiscal year ending June 30, 1898, together with an outline of work for the current fiscal year and recommendations for the future, presented in accordance with your letter of instructions.

Respectfully,

F. LAMSON-SCRIBNER,  
*Agrostologist.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

The work of grass and forage-plant investigations authorized by Congress to be conducted through this division has been prosecuted along the several lines indicated in my last annual report, and a fair measure of progress has been made. There has been a constantly growing interest on the part of farmers and stock raisers in the work of the division, resulting in a large increase in the amount of office work and in extending very markedly the field investigations. The value and necessity of actual field work is becoming more and more apparent, as well as the importance of experimental cultures of those grasses and forage plants which we may wish to propagate and introduce into cultivation.

By the field observations made through the agents of the division, we are becoming better acquainted with the needs of the several sections of the country and the forage problems with which these sections have to contend. We are thus acquiring a knowledge of the native grasses and forage plants, their distribution, their relative abundance, their value as they exist to-day, and the peculiar conditions of soil and climate under which they best thrive, the means by which they may be propagated, and their possible value in agriculture or in the economic arts.

#### GRASS GARDENS.

In the grass gardens of the Division of Agrostology there have been brought together for individual and comparative study many varieties of grasses and forage plants of this and other countries.

#### THE GRASS GARDEN ON THE GROUNDS OF THE DEPARTMENT.

In the grass garden on the grounds of the Department of Agriculture, although of limited area, nearly 500 varieties of these plants have been grown during the past season. This living collection of



forage plants has attracted a great deal of attention, and has been the means of imparting valuable information to a great many. Visitors to the city of Washington from all parts of the country have been much interested in what it was possible to see and to learn here. Lawn grasses have been grown in considerable variety, each being treated in a way to show its special value for lawns. Many varieties of grasses from the East, from the South, and especially from the West, have been grown here with success, and it is interesting to note the peculiar habits of the grasses of the moist and wooded regions of the East and those of the arid, treeless regions of the West, as displayed in this garden, where they may be seen growing side by side. A large number of leguminous plants have been given a place in the garden, and one of the interesting experiments has been a trial of alfalfa grown from seed obtained from more than twenty different sources.

Under the direction of the Secretary, alfalfa seed was procured from widely separated points in this country (from New York and New Mexico, from Colorado and Arizona, and from Nebraska and California) and other seed was obtained from foreign sources, including Russia, Germany, Austria, France, New South Wales, Algeria, and India. This seed, raised under most varying conditions, has been grown in the garden for the purpose of determining whether it would produce plants of varying character, and also to determine whether, as has often been claimed, there is any appreciable difference in the vigor or vitality of American-grown and foreign-grown seed. Trial samples of these seeds were sent to a number of experiment stations where cooperative experiments are being conducted, chiefly in the Western States. It is too early to draw conclusions of importance relative to this experiment, but it may be stated at the present time that very little if any difference has been detected between plants from American-grown seed and those from seed obtained from foreign sources. They have all grown with equal vigor and the plants of American origin have made as good growth as those obtained from any of the foreign sources. Up to the present time it has not been possible to detect any marked variation in the plants grown. There is, however, a character possessed by the Turkestan alfalfa which may serve to distinguish it from the other varieties, and that is the minute hairiness on the under surface of the leaves, visible when viewed with a pocket lens. This variety of alfalfa appears to be less susceptible to early and late frosts and has made remarkable growth in some of the experiments conducted in the West. At one station at North Yakima, Wash., it made a growth of over 3 feet in seventy-nine days, sending up many stems from each root.

An interesting exhibit in the garden has been that of two varieties of perennial beans from the tablelands of New Mexico. These beans have large fleshy roots which enable them to withstand drought to an extraordinary degree. It is hoped that some of the many species of native perennial beans will show adaptability to cultivation and will eventually contribute largely to the solution of the forage problems presented in the arid and semiarid portions of the West and Southwest.

Among the many foreign species grown in the garden may be mentioned the Tsama watermelon, a native of the Kalahari Desert, South Africa. The fruits of this melon are depended upon by wild game and such stock as are pastured in the desert and by travelers whose necessities compel them to cross this region. It is stated that on account of the absence of water it would be impossible to traverse this territory at

certain seasons of the year were it not for this melon, which supplies a palatable substitute for drinking water and food. If this melon could be established in the Mohave Desert, Death Valley, and other similar tracts in southern California, Arizona, and Nevada, it would doubtless prove a valuable acquisition. A quantity of this melon seed was intrusted to parties in Arizona and a successful growth of it was made at the experiment station of that Territory.

The plot of buffalo grass referred to in former reports has maintained its pleasing growth and attractive appearance, and the neat turf which it forms has not failed to elicit remarks of surprise and admiration.

Among the pasture grasses grown in the garden, smooth brome grass and blue grama seem to be the most promising. The seed of blue grama is easily harvested, and so far as our experiments go, it grows readily from seed. We believe that the propagation of this grass upon the cattle ranges of the West would greatly improve their value for grazing.

#### THE GRASS GARDEN AT KNOXVILLE, TENN.

The grass garden at Knoxville, Tenn., has been maintained during the year on the lines indicated in my last report, and many varieties of grasses and forage plants have been grown, seeds of which have been supplied by this division. For several reasons it has been deemed best to discontinue this garden and to select a station farther south which shall be more typically southern in its character both in soil and climate. Owing to the lack of uniformity of character in the land of the Knoxville Station, it was practically impossible to establish there comparative plot experiments. We already know that if the land is properly prepared—and no one ought to think of attempting to establish a permanent meadow or pasture on poorly prepared land—any of the varieties of grasses or forage plants which the market affords may be grown successfully, not only at Knoxville, Tenn., but throughout the entire region surrounding and represented by this point. We know that cowpeas, Indian corn, sorghum, clovers, orchard grass, timothy, redtop, and Bermuda grass can be grown and are grown in Tennessee and in the adjoining States as successfully as anywhere in the United States. The problem is not what can be grown, but how to grow the largest amount of the best quality with least expense, a problem which the agricultural experiment station at Knoxville is now well prepared to solve. In the region bordering the Gulf of Mexico it remains yet to determine what to grow for forage as well as how to grow it. In addition to the experiments made directly under our supervision in these grass gardens, numerous volunteer experimenters, to whom we have sent seed, have aided us materially in our work. Reports from these parties, who are all careful and intelligent farmers or stockmen, are now being received and will doubtless yield us information of much interest and real value.

#### INVESTIGATIONS IN THE SOUTHWEST.

In connection with the investigations in the Southwest, Prof. C. C. Georgeson, who for some months was employed as a special agent in this division, was sent to Texas in February under instructions to organize a series of experiments in range improvement. Two localities were finally selected for carrying on this work, one at

Channing, in the extreme northwestern part of the Panhandle, and one at Abilene, in central Texas. The primary object of these experiments is to determine the possibility of improving by practical methods the conditions of the cattle ranges and pasture lands which have deteriorated through overstocking or other causes. Each station embraces 640 acres, which has been fenced and cross fenced, dividing the land into 40 and 80 acre lots. Each lot is being treated differently, either by pasturing or by keeping the stock off during a part or the whole of the season or at stated intervals, or by disk harrowing some of the areas or scratching the surface with straight-toothed harrow, by sowing seed on the native sod or on the areas harrowed, and in addition to this line of experiments, one area, especially at the Abilene station, has been set aside for the cultivation of those varieties of grasses and forage plants which are likely to prove valuable, but which will at first need more or less care and attention in order to secure and maintain their growth. The special agent in charge of the Abilene station reports that a decided improvement is already apparent in the land which had been disked and harrowed early in the spring. Of the range experiments carried on at these two stations, those made at Abilene will in a general way serve for all central and western Texas and southern portion of New Mexico; those conducted at Channing for the Texas Panhandle, western Kansas, Oklahoma, southeastern Colorado, and northeastern New Mexico. It is believed that the results of the work at these stations will prove of great value to thousands of stock owners in our great Southwestern region.

Cooperative work among farmers similar to that employed for alfalfa, is being performed in Colorado, the Dakotas, Wyoming, Montana, and Idaho. The objects of these experiments, which are numerous, but on a small scale, is the introduction of new or little known or desirable hay and pasture grasses and soiling crops. A considerable number of the more progressive ranchers and stockmen of this region have agreed to devote from 1 to 5 acres each of cultivated land to certain of the more promising native grasses and to grasses introduced from foreign countries.

#### GRASS SEED DISTRIBUTION.

Seeds of the grasses and alfalfa imported by the Secretary from Russia and eastern Asia were sent in amounts sufficient to sow from one-twentieth of an acre to an acre of each variety to 479 persons, most of them in the West and Northwest. These seeds were sent only to those who had previously agreed to give them careful cultivation and to report fully concerning their results at the close of the experiments. The data thus secured can not fail to be of great interest and value to farmers, ranchers, and all who are interested in the improvement of the forage resources of our country. In addition to this number about 1,100 packages of native grass seeds, saltbushes, wild clovers, wild beans, alfalfa, soiling crops, and lawn grasses, mostly collected by employees of the division, were distributed to our correspondents, who expressed their willingness to cooperate with the division in its investigations. Among the many native grasses sent out were curly mesquite, side oats grama, and mutton grass from the Southwest, and slender wheat grass from the Northwest. In addition to the Russian seeds a quantity of seeds of several varieties were collected for the use of the division by the agents of the botanical



department of the Northwest Province of India, and these have been sent to parties living in those sections where the grasses would be most liable to grow and thrive.

#### FIELD WORK.

The field work of this division during the past year has been the continuation of the lines already started and their extension to embrace other territory which had not been previously included.

In continuation of the work upon lawns and lawn grasses and upon ornamental grasses used in landscape gardening, the chief of this division has visited a number of the larger cities of the East for the purpose of conferring with park superintendents and commissioners and to secure photographs and samples wherever obtainable. The results of these investigations were published in the Yearbook of the Department for 1897 and enlisted much correspondence and interest among lovers of fine lawns.

As mentioned in the previous annual report, the assistant chief of this division spent three and one-half months in Texas and New Mexico under instructions to secure all possible information in regard to the existing forage conditions of the cattle ranges by direct observations and by consultation with the leading stock owners. He was also directed to study the distribution of the native forage plants, securing, as far as possible, seeds and specimens of all those plants which are considered of value for furnishing feed for range stock, and wherever the carrying capacity of the cattle ranges had been diminished by drought, overstocking, or the rapid increase of weeds or destructive pests, to collect information as to the best remedial method to be employed in again bringing the land up to its full value. He was also directed to study the relation of the soils to the growth of grasses and the effects of temperature, rainfall, and habitat on the growth and dissemination of the native and introduced forage plants. A bulletin embodying these observations in the field during the past three years and the results accomplished is nearly ready for submittal.

For the purpose of collecting native grasses and forage plants and to obtain notes on their geographical distribution and practical economic value, Mr. Thomas A. Williams, an assistant in the division, spent three months in Wyoming, Montana, and Idaho. The notes and observations secured by him have been incorporated in a report and published as Bulletin No. 12, entitled "A report upon the grasses and forage plants and forage conditions of the eastern Rocky Mountain region."

A commission was given Prof. Aven Nelson, of the University of Wyoming, to investigate the forage resources of the Red Desert, a region in southwestern Wyoming, comprising an area about the size of the State of Massachusetts, waterless, and hence uninhabitable during the summer season, but noted as a winter-grazing ground, where hundreds of thousands of head of sheep and cattle are fattened. Professor Nelson made notes upon the occurrence and distribution of the wild forage plants, their forage value, and other points of interest or value to the stockmen, who depend on the natural growth of this region for winter feed for their stock. He also collected quantities of seeds of salt sages, sage bushes, winter fat, and shad scale for trial under cultivation, and a full set of botanical specimens not only of the plants of economic importance, but of all of the species of this little-known region. The report of his work is now in press and will soon

appear as Bulletin No. 13, entitled "The Red Desert of Wyoming and its forage resources."

Work similar in character was undertaken in southwestern Colorado by a special field agent. After a few weeks spent in this work the agent was unfortunately taken with a serious illness and was unable to complete the investigations planned.

Prof. S. M. Tracy, formerly of the Mississippi Experiment Station, was authorized to visit points in Mississippi, Alabama, and Florida for the purpose of preparing notes to be used in a report on the grasses and forage plants of the Gulf States. This report has been written and is now in the hands of the Public Printer for publication as a bulletin of this division.

Mr. H. L. Bentley, of Abilene, Tex., who has resided in central Texas for many years, and who is thoroughly acquainted with the past and present conditions of the ranges there, was authorized to prepare a report upon the grasses and forage plants of central Texas. Mr. Bentley in his report has made use not only of facts which have come under his own observation, but has consulted freely with stockmen who date back to the early years of the stock industry in Texas. The facts, as represented by him and by many of the leading stockmen of that region, illustrate the remarkable changes which may occur in vegetation, climate, and natural conditions of a country as the result of thriftless methods and the unintentional destruction of the natural resources of the finest grass country in the United States. Not only has he treated of the history of the destruction of the grasses, but has made a number of recommendations, which, if followed by Southwestern stockmen, will result in marked increase in the value of the grazing lands of the State.

#### ROUTINE WORK OF THE DIVISION.

With the constant increase in the number of correspondents of the division which has naturally followed the expansion of the work there has been a constant increase in the amount of routine work, and it has become necessary to devote much time to correspondence concerning the grasses, the identification of specimens, the preparation of manuscripts for publication, and similar labor, which greatly diminishes the time for original and scientific investigations. About 350 letters were written in answer to inquiries concerning methods of cultivation, uses, and feeding value of grasses; in addition, 2,100 letters were written relating to other subjects. The preparation of drawings for the illustration of the "Handbook of American grasses" has been continued nearly to the point of completion. Over 700 of the species and varieties have been thus prepared for publication, and the remainder, which will require further study or delimitation, will be prepared as soon as possible. The list of correspondents has increased to over 6,000 among the farmers and cattle men, and there is an additional list of about 600 scientists and botanists to whom the botanical publications are sent. Much of the voluminous correspondence has been in relation to the identification of species of American grasses, and over 5,000 have thus been named during the fiscal year.

#### HERBARIUM WORK.

The work on the herbarium has continued with as little intermission as possible. The collection is rapidly growing; 2,900 mounted

sheets were added during the fiscal year. The majority of the specimens acquired have been secured by field agents and members of the division force during their field investigations, while a part of the balance was deposited by the Smithsonian Institution and the Division of Botany, and a large number were donated by collectors. An effort has been made to strengthen the weak points in the herbarium by exchange with foreign botanists, and ten sets of from 100 to 250 species each have been distributed with this end in view to foreign agricultural departments and botanic gardens, and a large quantity of valuable foreign material has already been received in exchange. The Department is rapidly acquiring a grass collection which can not be excelled, at least so far as American grasses are concerned, by any herbarium in the world.

#### PUBLICATIONS.

The publications issued by the division during the past fiscal year are as follows:

*Divisional bulletins.*—No. 7 (revised), American Grasses, by F. Lamson-Scribner; No. 9, Notes on the Grasses and Forage Plants of Iowa, Nebraska, and Colorado, by L. H. Pammel; No. 10, A Report upon the Grasses and Forage Plants of Central Texas, by H. L. Bentley; No. 11, Studies on American Grasses, by T. H. Kearney, jr., and F. Lamson-Scribner; No. 12, A Report on the Grasses and Forage Plants and Forage Conditions of the Eastern Rocky Mountain Region, by Thomas A. Williams.

*Farmers' Bulletins.*—No. 58, The Soy Bean as a Forage Crop, by Thomas A. Williams; No. 31 (revised), Alfalfa or Lucerne, by Jared G. Smith; No. 66, Meadows and Pastures, by Jared G. Smith; No. 72, Cattle Ranges of the Southwest, by H. L. Bentley.

*Circulars.*—No. 5, Cowpeas, reprinted from the Yearbook for 1896, by Jared G. Smith; No. 6, The Cultivated Vetches, by Jared G. Smith; also a revised edition of No. 6.

*Papers for the Department Yearbook for 1897.*—Division of Agrostology, by F. Lamson-Scribner; Lawns and Lawn Making, by F. Lamson-Scribner; Leguminous Forage Crops, by Jared G. Smith.

*Circular of Inquiry.*—Agros. 28, Grasses and Forage Plants of the Gulf States.

#### PLANS FOR THE CURRENT FISCAL YEAR.

Little more can be done under the appropriation for the current fiscal year than to carry on the work planned last year and now well in progress. The authorized field work and experiments could be made much more valuable and effective, and they could be carried on really more economically, under more liberal appropriations.

#### RECOMMENDATIONS.

The general approval which the work of this division has received has been most encouraging, and it is to be hoped that it will be possible another season to extend the work and investigations of the division to the Pacific coast. Up to the present time our work has been limited to the Southern States and the Atlantic slope. The work already done in this region has been very successful, and the facts already learned have more than justified all expenditures thus far



made. There is at present great interest being developed in the investigations of forage plants on the Pacific slope, and the time has arrived when any work which the Department can do in that region may be prosecuted under the most favorable circumstances, and will be very highly appreciated. I would also urge the extension of our field observations to our new possessions in the south and in the Pacific. In the islands of the West Indies we will doubtless find many useful grasses and other forage plants adapted to cultivation in the Gulf States, where forage plants are greatly needed. Such plants as are now grown in the Gulf-coast region, and which are most highly prized, came from more southern latitudes. The work being done in the United States should be continued along the lines already laid down, and in order to make this work most effective a larger appropriation than that heretofore made will be necessary. The field work covered is so broad that the present appropriation is insufficient to meet the demands made upon it. The great importance of the work, investigations of grasses and forage plants, constituting the basis of all good agriculture, and the extent of the economic questions involved, I believe fully warrant the appropriations for which estimates have already been submitted.

## REPORT OF THE BOTANIST.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF BOTANY,  
*Washington, D. C., October 5, 1898.*

SIR: I have the honor to submit herewith my sixth annual report as Botanist of the Department of Agriculture, covering the year ending June 30, 1898.

Respectfully,

FREDERICK V. COVILLE,  
*Botanist.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

#### PLANT RESOURCES.

In the annual report of the Botanist for 1895, and again in the report for 1897, was urged the desirability of studying the correlation of different types of natural vegetation with the different kinds of agricultural soils, in order to judge the extent of a particular soil by the vegetation it bears. During the latter part of the fiscal year investigations in this line were inaugurated, Mr. T. H. Kearney, jr., having been transferred for this purpose from the Division of Agrostology.

Preliminary circulars have been sent out requesting information on the distribution of five common and well-known shrubs and trees native to the South and West, and on the crops adapted to the soils upon which these trees and shrubs naturally grow. Field work has been begun in eastern Virginia and adjacent parts of North Carolina, with special reference to the vegetation of the soils upon which truck crops and corn are grown.

During the summer of 1897 an assistant botanist was sent to the Round Valley Indian Reservation, California, to ascertain the uses of native plants among the obscure and little-civilized Indians of that reservation. Great as is our desire to place on record all information obtainable on this subject, only one member of the division force could be spared for this important work during the past year.

The work of Mr. John B. Leiberg, formerly a field agent of the division, on the plant resources of the Columbia Plains, was interrupted at the beginning of the fiscal year by his transfer to the Geological Survey. That department of the Government, having been intrusted with a topographical and statistical survey of the forest reserves, was in need of men trained in timber examination, and this transfer was made in pursuance of a general policy to render all possible assistance to other branches of the public service.

In connection with the botanical exploration work of the Division of Botany in the summer of 1897 the Botanist undertook a special examination of the effect of sheep grazing on the forests of the Cascade Mountains of Oregon. Since the establishment of the Cascade Forest Reserve, in 1893, a keen and sometimes bitter controversy has been carried on by the people of Oregon over the question of sheep grazing within the reserve. Legislation by Congress having made it necessary to devise a series of regulations regarding this industry, and the information in the possession of the Interior Department consisting of a mass of exceedingly conflicting testimony, the need of a disinterested investigation of the facts was felt, and the aid of the Department of Agriculture was solicited. The result of this investigation was published as Bulletin No. 15, Division of Forestry, entitled "Forest growth and sheep grazing in the Cascade Mountains of Oregon."

#### NEW OR LITTLE-KNOWN CROPS.

*Chicory.*—In the year 1896 the United States imported 16,317,888 pounds of chicory, chiefly grown in Belgium, having a wholesale value of \$226,077. In the belief that this crop could be grown profitably in the United States and the farmers of this country enriched by the amount cited, an investigation was begun, the results of which have been published as Bulletin No. 19 of the Division of Botany, entitled "Chicory growing as an addition to the resources of the American farmer."

*Ginseng.*—In the year 1895 the division published a bulletin showing that the export of wild American ginseng, which in 1893 was valued at \$792,928, was constantly decreasing in amount, while the price per pound was constantly advancing; that the commercial extermination of the wild plant was threatened; and that there was good promise of success for those who would undertake its cultivation. A continued demand for information on the subject led to the preparation of a revised edition of this bulletin, in which it is shown that the commercial status of American ginseng is still firmer than in 1895; that meanwhile the root has been cultivated and marketed successfully on a small scale, and that by the exercise of industry, intelligence, and patience cultivated ginseng may be made a profitable crop.

*Horse-radish.*—The consumption of horse-radish as a condiment has increased largely in the past few years, and the growing of the plant itself, instead of being confined to the garden of the consumer, has recently come into the hands of market gardeners. A popular desire to know more specifically how to produce a good quality of the root led to the preparation of a short paper on the subject, published as Circular No. 15.

*Castor bean, etc.*—An investigation of the culture of the castor bean has been completed, with the exception of certain chemical work, and studies of melons recently imported from Russia, and of the growing of bulbs have been begun.

#### POISONOUS PLANTS.

Owing to the entire lack of laboratory facilities the investigation of poisonous and medicinal plants has been largely conducted through the medium of correspondence and compilation. The division is constantly receiving requests for information concerning the identity of poisonous plants and antidotes therefor. These requests arise chiefly



from the frequent cases of serious and sometimes fatal illness resulting to children and others from eating various portions of deleterious plants. To supply this demand an illustrated Yearbook article by Mr. V. K. Chesnut, entitled "Some common poisonous plants," and an illustrated circular by the chief of the division, entitled "Observations on recent cases of mushroom poisoning in the District of Columbia," have been issued. An illustrated paper by Mr. Chesnut, entitled "Principal poisonous plants of the United States," was in press at the end of the fiscal year, and has since been issued.

In cooperation with the Pan-American Medical Congress, printed blanks have been sent out asking for detailed information regarding the abundance, distribution, and medicinal uses of native plants preliminary to a comprehensive report by that body on the medicinal plants of the United States.

#### PURE-SEED INVESTIGATIONS.

Our pure-seed investigations have been carried on along two lines: (1) The practical testing of the purity and vitality of commercial seeds, and (2) the investigation of difficult problems in connection with the selection, improvement, and germination of such seeds. One hundred sets, containing 500 specimens each of seeds of grasses, weeds, clovers, and other forage and economic plants, have been prepared for distribution to agricultural colleges and experiment stations, and to foreign seed control stations, in exchange for information furnished to the division. These specimens are neatly labeled and put up in substantial trays of heavy cardboard. Repeated requests have been made by seedsmen, experiment-station workers, and others for authentic specimens of this kind. As a working collection it is believed that this set of economic seeds will prove of unusual value to its recipients.

*General seed tests.*—The testing of Government seeds during the past year has required less effort than before, owing chiefly to the fact that the seeds were purchased from one firm. Only 1,830 laboratory and greenhouse tests have been required, as against 5,288 tests for the preceding year. In addition to these tests, for the first time in the history of the Department all the varieties of Congressional seed distributed by the Department have been tested in the open field. This work was efficiently done at Kensington, Md., on the trial grounds of the division, by Mr. W. W. Tracy, jr. The fact that some twenty varieties of common garden vegetables proved to be entirely untrue to name, shows the importance, independent of other considerations, of making these field tests. Experiments have also been conducted on the trial grounds concerning the relative value of large and heavy seeds for planting. These experiments are a continuation of those previously made in the division greenhouse, and confirm the results already obtained, namely, that in the end it will pay the farmer well to carefully select large seed as far as possible for planting and throw away the smaller grains. A report embodying the results of these field experiments is now in preparation. The trial grounds were enlarged this year, so that they now embrace  $2\frac{1}{2}$  acres. The cost of maintenance, outside the salary of one assistant, has thus far been trivial.

*Testing seeds imported by the Department.*—Owing to the great danger of importing serious weed pests in the seed which is being received from Russia and other foreign countries, the seed laboratory has undertaken to test all of the samples which pass through the Section of Seed

and Plant Introduction. The importance of this work is evidenced by the fact, for example, that out of a large number of samples of Turkestan alfalfa examined, scarcely one was free from a foreign species of dodder. When this fact was ascertained it was at once reported upon, so that the bulk lots might be thoroughly cleaned. I would strongly recommend that instructions be issued to the different divisions of the Department distributing seeds in any way, whether collected in America or abroad, to submit fair samples of such seed to the Division of Botany for test before any of it is sent out. In this way the possibility of unwittingly introducing serious pests into portions of the country where they are not known would be effectually prevented.

*Seed collection.*—Over 4,000 specimens were added to the seed collection during the year, making a total number at present of about 20,000.

*Vitality of old seeds.*—Tests are now being conducted in the seed laboratory to ascertain the average duration of vitality of vegetable and grass seeds.

#### WEEDS.

The work on weeds has consisted largely in correspondence, the determination of plants which have appeared as new weeds in various localities, and the furnishing of information as to their character and the best method for their eradication. Data have also been collected in regard to the range, distribution, and method of control of weeds. A "Report on dodders infesting clovers and alfalfa" was published as Circular No. 14. An investigation has also been undertaken in regard to the burs injurious to wool and in regard to the plants which impart a disagreeable taste to dairy products.

#### PERFUMERY PLANTS.

Nearly all the perfumery used in this country is imported, partly as finished product, and more largely as raw material. Many standard perfume plants can probably be grown with success in this country, while many native plants give promise of yielding attractive perfumes. An investigation of the feasibility of producing the raw materials of perfumery in the United States has been undertaken, and some of the facts learned will be set forth in an article prepared for publication in the Yearbook of the Department for 1898.

#### CORRESPONDENCE.

About 5,000 letters have been written during the year. These have been chiefly replies to inquiries about plants. Whenever possible, such inquiries are answered by circulars and other publications. A large number of plants, mostly weeds, and supposed useful or injurious plants, together with seeds, have been received for identification.

#### EXHIBIT AT THE TRANS-MISSISSIPPI EXPOSITION.

An exhibit, illustrating the principal poisonous plants in the United States, the most important commercial seeds and their common impurities, seed-cleaning machinery, and the apparatus and methods used in testing seeds in the seed laboratory, was prepared for the Government exhibit at the Omaha Exposition and duly installed.

## PUBLICATIONS.

The following publications, prepared in the Division of Botany, were issued during the year:

*Bulletins*.—No. 19, *Chicory Growing as an Addition to the Resources of the American Farmer*, by Maurice G. Kains, issued May 21, 1898; *Farmers' Bulletin No. 28, Weeds, and How to Kill Them* (reprint), by Lyster H. Dewey, issued May 12, 1898.

*Contributions from the U. S. National Herbarium, Vol. V, No. 3*.—*Studies of Mexican and Central American Plants*, by J. N. Rose, issued August 27, 1897.

*Circulars*.—No. 12, *The Camphor Tree*, by Lyster H. Dewey, issued August 25, 1897 (revised edition issued September 29, 1897); No. 13, *Observations on Recent Cases of Mushroom Poisoning in the District of Columbia*, by Frederick V. Coville, issued December 11, 1897 (revised edition issued February 15, 1898); No. 14, *Dodders Infesting Clover and Alfalfa*, by Lyster H. Dewey, issued May 2, 1898; No. 15, *Horse-Radish*, by Maurice G. Kains, issued June 10, 1898.

*Report*.—*Report of Botanist for 1897*, by Frederick V. Coville, issued May 14, 1898.

*Papers prepared for the Department Yearbooks for 1896 and 1897*.—*Some Common Poisonous Plants*, by V. K. Chesnut, *Seed Production and Seed Saving*, by A. J. Pieters, and *The Superior Value of Large Heavy Seed*, by Gilbert H. Hicks and John C. Dabney, issued July 19, 1897; *Migration of Weeds*, by Lyster H. Dewey, issued July 21, 1897; *Division of Botany*, by Frederick V. Coville, issued May 24, 1898; *Additional Notes on Seed Testing*, by Gilbert H. Hicks and Sothoron Key, issued May 24, 1898.

## IMPROVEMENTS AND PLANS FOR THE FISCAL YEAR 1899.

The work of the Division of Botany has been considerably hampered during the past and preceding years by its cramped and inconvenient quarters, but the agricultural appropriation act for the fiscal year 1899 carries an item for the rent and alteration of a more commodious building, which will be occupied as a botanical laboratory.

## GREENHOUSE.

The greenhouse facilities available for our use having become inadequate for our increasing experimental work, authority was asked of Congress, and secured, to erect a suitable plant house for this purpose. This house, which will greatly facilitate our investigations, should be ready for occupancy before the end of the year.

## SEED-TEST LAW.

The act of Congress making appropriations for the Department of Agriculture for the fiscal year ending June 30, 1899, under the heading "Botanical investigations and experiments, Division of Botany," contains the following clause:

The Secretary of Agriculture is hereby authorized to purchase samples of seeds in open market, test same, and when found not up to standard he may, at his discretion, publish the results of these tests, together with the names of the seedsmen by whom the seeds were sold.



Under date of May 10, 1898, a circular, signed by the Secretary of Agriculture, was sent out to seedsmen, announcing the conditions under which these tests would be made, and stating that it would be the aim of the Department of Agriculture in carrying out this law to put a stop to the sale of seed so poor as to make probable a positive injury and loss to the purchaser, thus giving protection on the one hand to the farmer and gardener and on the other hand to the honorable seedsman and seed dealer.

#### AMERICAN SEED GROWING.

At the present time a large amount of the vegetable and grass seed used in America is imported. The new and destructive weeds which appear in this country from year to year are principally introduced through the medium of this imported seed. To minimize this danger, and also to aid in building up what has already proved a great industry in some sections of the country, the Division of Botany proposes this year to inaugurate a series of field investigations on the growing of those varieties of flower, vegetable, and grass seeds which are now wholly or chiefly secured from abroad.

#### FUTURE PLANS.

##### PARIS EXPOSITION.

An exhibit of some of the principal plants and plant products of this country should be prepared by the Division of Botany during the coming year for the exposition at Paris in 1900. It would be superfluous to lay special emphasis on the fact that any exhibit sent to Paris as illustrative of so important a branch of our national industries should be worthy of its subject. It is almost needless, too, to point out that the regular force of the Division of Botany can not do more than give a plan and direction to such work without seriously interfering with investigations now in progress. Provision should be made, outside our current appropriations, for the employment of the labor necessary in the preparation of such an exhibit.

##### PLANT RESOURCES OF HAWAII AND OTHER TROPICAL POSSESSIONS.

Already inquiries have reached the division concerning the plant resources of Hawaii, Puerto Rico, the Philippines, and Cuba. A thorough botanical survey of the economic plants of such of these countries as may come into the possession of the United States should be undertaken as soon as practicable. A report upon the economic plants, both cultivated and native, of each country we shall acquire would be eagerly welcomed by the American people and would be widely useful.

## REPORT OF THE DIRECTOR OF THE OFFICE OF ROAD INQUIRY.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF ROAD INQUIRY,  
*Washington, D. C., August 31, 1898.*

SIR: I have the honor to submit herewith the report of the Office of Road Inquiry for the fiscal year ending June 30, 1898, together with an outline of the work for the current year and estimates for the ensuing year. Owing to the fact that my appointment as director of this office took effect after the close of the fiscal year, that portion of the report covering the past year's work was prepared, at my request, by my assistant, Mr. M. O. Eldridge.

Respectfully,

MARTIN DODGE,  
*Director.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

The work of this office during the past fiscal year has continued and progressed under the same plans and methods as were laid down in the order for the organization of the inquiry. Thousands of copies of road literature have been distributed among farmers and others interested. Many important road meetings have been attended by representatives of the office, where information regarding the ways and means of road improvement was both collected and disseminated. Two of the agricultural colleges and experiment stations have received our cooperation and assistance in disseminating information. Road construction and management have been closely watched in many localities, and many road laws of the several States have been collected.

### LITERATURE.

The demands for information and advice upon the various phases of the road subject have continually increased. The literature relating to the construction and repair of all kinds of roads and that dealing with the road laws of the several States have been especially sought for, and many thousand documents have been distributed. In order to push the practical work in the field, as suggested by you, the office force has not been increased, and consequently the issue of didactic publications has not been as extensive as in previous years.

An important series of investigations entitled "Repairs of macadam roads" was published as Circular No. 30. Circular No. 24, entitled "Highway maintenance and repairs," has been revised, and, in addition to embracing the material contained in the original circular, contains extracts from Circulars Nos. 16 and 20 on "Highway taxation," "Comparative results of labor and money systems," and "Contract system of maintaining roads." Bulletin No. 16, entitled

"Employment of convicts in connection with road building," has also been revised, and contains, in addition to the original matter, a full description, with illustrations, of the convict quarry camp at the Folsom State prison, California, where the convicts are employed in preparing stone for road-building purposes. The correspondence for the year, including special and technical advice on road construction not treated in the publications, and practical suggestions regarding the best laws by which the best results might be accomplished, covers almost 2,000 press copy-book pages. The press of the country seems to have become thoroughly aroused in behalf of the road movement, and without doubt the papers have printed as much, if not more, in advocacy of good roads during last year as they have on any other one subject. In many cases circulars and bulletins from this office have been reproduced in full in the papers.

#### ROAD MEETINGS.

During the year a very successful meeting of the National Road Parliament, representing most of the Southern and some of the Northern States, was held at Nashville, Tenn., in connection with the Tennessee Centennial Exposition. A number of State conventions have been called, and road leagues have been organized in many progressive communities, all of which have resulted in organization and furtherance of the movement. Most of these conventions were largely attended, and it is believed that much good will result therefrom.

#### SAMPLE ROADS.

Mr. E. G. Harrison, road expert, has completed the object-lesson road at the Agricultural College of Rhode Island. His report upon the details of construction and cost, as well as other investigations and inquiries carried on by him during the year, will be prepared for the Yearbook of the Department for 1898. Frequent calls have been made on this office to provide road experts for the purpose of giving personal suggestions and advice, but on account of our small appropriation it was found in most cases impossible to meet these demands. For the same reason it has been necessary to discontinue the object-lesson road work in connection with the agricultural colleges and experiment stations, so far as financial aid is concerned. Many of these Government institutions are still urgently calling for assistance and cooperation in one form or another, and the greater number of them professing ability and willingness to do their part, that is, to furnish the material and labor and to pay part of the wages of experts sent in charge of machinery, leaving to this office only a small part of the expense, for the payment of freight on machinery and part payment of experts' salaries. Such a contribution from the Government is generally sufficient to procure help for them from the municipalities and citizens in their neighborhood. What work of this kind has been done so far has only been accomplished by trespassing on the small funds provided for office and traveling expenses, thus seriously interfering with other work. The great value and importance of this plan of cooperation has been fully demonstrated, as numerous communications addressed to this office will indicate. Without exception these have given the plan their highest commendation. If this work is to be pushed, it is obviously necessary that an additional appropriation should be made for the purpose.



## ROAD CONSTRUCTION.

Agents of some of the road machinery companies report that more road machinery has been sold during the past six months than in the whole of the preceding year. This and other observations made by this office indicate that actual construction of improved roads has progressed steadily in many States during the past year. It may be taken also as an indication that the masses of the people are becoming enlightened upon the scientific and economic principles of improved road construction.

## ROAD LAWS.

The feeling in favor of State aid continues to grow, and has been accelerated by the action of the legislature of New York in the passage of the Higbie-Armstrong bill. Of all the road bills introduced into the legislature of New York, this one appears to be the most practicable and the most capable of producing the greatest good to the greatest number. No new offices are created, the State engineer being placed in charge of all road work. The matter of road improvement is entirely permissive. Boards of supervisors are given the right to decide what roads, if any, are to be improved, and the bill provides that the State shall bear 50 per cent of the cost, the county 35 per cent, and the town in which the road is located 15 per cent. A highway commission has been appointed by the legislature of Maryland to investigate the road systems of the State, to locate the best road materials, and to furnish plans, estimates of cost, and all other details necessary to place the State in position to act intelligently on the subject. This is a good beginning for Maryland, and many of her sister States would do well to follow her example. The first thing to do in any new movement of this sort is to find out what is to be done and how to do it. The Hamilton road law has been passed by the legislature of Pennsylvania. This act provides for the election of road supervisors in the several townships of the Commonwealth, and authorizes them to make, repair, and maintain roads and bridges, let contracts for the same, levy and collect taxes, employ labor, etc.

## STEEL ROADS.

Under your injunction, this office has endeavored to promote experiments in steel roadways. During the year a section of 500 feet was successfully laid in Cuyahoga County, Ohio, immediately adjoining the city of Cleveland, by the recently appointed director of this office. This road is composed of inverted channel bars placed in such a position that they become a tramway or trackway. A broken-stone surface has been prepared for the horses to walk upon, and to enable the teamsters to take their wagons on and off the road at will. The road is laid in a street on which there is a large amount of heavy traffic, and has already demonstrated the great value of steel in road construction.

## OPERATIONS AND PLANS FOR 1899.

During the fiscal year 1898 the object-lesson work of road building by this Department has been diffused over a wider extent of territory than heretofore. Road Expert Harrison has completed such object-lesson roads near Belair, Md., and near Fork, in Harford County, Md.

After completing this work he was transferred to the State of Minnesota, where he is carrying on the work of instruction, both by addresses at public meetings and by means of an object-lesson road upon the State Fair Grounds. After continuing the work in the West, it is proposed that Mr. Harrison shall perform some other work in Vermont and New England, and later go forward with some experimental work at the agricultural college in Maryland, where he has already done preliminary work by way of a lecture before the students of that institution.

Plans have been prepared in this office for the construction of a sample steel road 510 feet in length to be laid upon the grounds of the Trans-Mississippi Exposition in Omaha. The contract for the steel work has already been let to the Cambria Iron Company, and it will be completed in a few days. It is the purpose of the director of this office to proceed to Omaha and superintend the laying of this track upon the roadway connecting the main street of the exposition with the Indian village, where it can be seen and examined by all persons attending the exposition. It is also proposed to make traction tests upon this steel road, with a view to showing how much less power would be required to move vehicles over such a road than over any other heretofore built. It is expected that this experiment will show that steel roads can be built at no greater cost than other hard roads, that when built they will last many times as long with but little repair, and that the power required to move a vehicle will be reduced to a small fraction of that which is now required. It has been claimed that an animal can move fifty times its weight over such a road as is to be built at Omaha. The tests to be made by this object-lesson road will prove or disprove these claims.

#### PLANS AND ESTIMATES FOR 1900.

During the past two years the usefulness of this office has been somewhat impaired by insufficient appropriations. The sum of \$10,000, which was formerly appropriated for this office, is none too much to do the ordinary work which presents itself in regular course. In addition to this sum there should be at least \$2,000 appropriated for the purpose of making experiments and traction tests with wide-tire wagons, and also to assist agricultural colleges in object-lesson work in the various States.

I therefore recommend that the sum of \$12,000 should be appropriated for the use of this office for the year 1900; being \$10,000 for office and ordinary expenses, \$2,000 for experiments with broad tires, and assisting the agricultural colleges of the different States.

*Detailed estimate of expenditures for the fiscal year ending June 30, 1900.*

Ordinary expense: Salaries, office, and traveling, as provided for in 1898 and 1899.....	\$10,000
For experimenting with wide-tire wagons.....	500
To aid agricultural colleges in the different States.....	1,500
Total.....	12,000

## REPORT OF THE CHIEF OF THE SECTION OF FOREIGN MARKETS.

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U. S. DEPARTMENT OF AGRICULTURE,  
SECTION OF FOREIGN MARKETS,  
*Washington, D. C., September 1, 1898.*

SIR: I have the honor to submit herewith the report of the Section of Foreign Markets for the fiscal year ended June 30, 1898.

Respectfully,

FRANK H. HITCHCOCK,  
*Chief.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

One of the most important features of the work accomplished by the Section of Foreign Markets during the fiscal year ended June 30, 1898, was the preparation of responses to the numerous inquiries received from correspondents seeking information relative to our foreign trade in agricultural products. The wide distribution given some of its more recent publications has brought the section into more general notice and resulted in much larger demands upon it. These demands have come not only from private sources, but also in many cases from Members of Congress and departmental officials. By request of the Secretary of State, the services of the office were placed at the disposal of the special commissioner appointed by the President to negotiate reciprocity treaties with foreign countries, and much time was devoted to the compilation of data required in that connection. Such time as remained after meeting these various demands has been utilized in the preparation of additional bulletins and circulars upon subjects of special interest.

#### COMMERCE OF THE HAWAIIAN ISLANDS.

The first publication prepared during the fiscal year was a report upon the commerce of the Hawaiian Islands. At the time of its preparation great interest in the islands had been created by the discussion regarding their proposed annexation. The report, which was issued in the form of a circular, following in general plan a preceding circular on our trade with Cuba, had a wide distribution. It gave a comprehensive review of Hawaiian commerce during the last ten years, and especially of the trade relations between the islands and the United States, describing in detail the character and value of the merchandise exchanged. The original issue of this circular, amounting to 10,000 copies, was some time ago exhausted, but as the demand for it still continued, a revised edition has recently been prepared and published.



## WHEAT IN AUSTRIA-HUNGARY.

Following the review of Hawaiian commerce, a report was prepared regarding the status of Austria-Hungary as a wheat-producing country. The investigation of this subject was undertaken because of the deep interest that existed at the time in the statistical position of wheat. Owing to a remarkable shortage in the crops of European countries, coupled with an abundant harvest in the United States, an unusual demand for American wheat was created abroad. It was ascertained that considerable quantities of United States wheat were being imported into Austria-Hungary, a country that had generally been regarded as a source of supply for other nations of Europe. This fact indicated that a decided change had occurred as regards the wheat situation in the Austro-Hungarian Monarchy, and suggested the desirability of securing more accurate information upon the subject. A careful investigation was accordingly made regarding the course of wheat production, exportation and importation in that country during the last ten years. As a result of this investigation it was shown that while the Austro-Hungarian wheat harvests had not decreased in size during the decade, the tendency had been toward a larger home consumption of the national product and a consequent reduction of the surplus available for shipment to other lands. The facts brought out were of special interest as indicating the lessened importance of Austria-Hungary among the countries with which the United States is obliged to compete in the wheat markets of the world. The results of the inquiry were published in a circular.

## OUR FOREIGN TRADE IN AGRICULTURAL PRODUCTS.

The next report prepared by the section had for its subject our foreign trade in products of agriculture. It gave a full account of our agricultural imports and exports during each fiscal year from 1893 to 1897, inclusive, with detailed statistics as to the annual quantity and value of the various articles comprised in this branch of our commerce. The relative value of the agricultural produce imported and exported as compared with the imports and exports of other classes of merchandise was shown, and also the average annual import and export prices of the several products for each of the five years covered by the statistics.

In the preparation of this report, the list of articles that had been used in previous statements of our agricultural imports and exports published by the Department was subjected to a careful revision. The old classification was found to contain a number of inconsistencies, as well as many omissions. These defects were corrected as far as possible, and it is believed that the classification in its revised form makes a much more complete and accurate showing of our agricultural trade than any hitherto printed.

The report was originally issued in the form of a bulletin, but as the subject-matter was one of very general interest, the most important facts were afterwards republished in a circular, of which 85,000 copies were distributed.

## SPAIN'S FOREIGN TRADE.

As soon as the prospect of war between the United States and Spain became apparent, the preparation of a report upon Spain's foreign trade was begun. The report was planned with the idea of showing

how largely and in what directions the commerce of that country was likely to be affected by the breaking out of hostilities. With this end in view, the character and extent of Spain's commercial relations with each of the several foreign countries were carefully described. Full information was also given regarding the status of the Spanish merchant marine and the amount and direction of the shipping conducted under the Spanish flag. All the information presented was based upon official statistics published by the Spanish Government. The report was issued in the form of a bulletin, and was given to the public a few days before the declaration of war, at a time when the information it contained was of peculiar interest.

#### OUR TRADE WITH SPAIN.

The bulletin on Spain's foreign trade was supplemented by a report dealing solely with the commerce that had been carried on between that country and the United States. Detailed statistics were given as to the quantity and value of our imports of Spanish merchandise during a period of ten years, and also as to the quantity and value of the American goods marketed in Spain. The data presented showed very clearly what commercial interests in the United States would be most affected by the interruption of our Spanish trade. This bulletin, like the preceding one, appeared at an opportune time, and the demand for it was equally large.

#### TRADE OF PUERTO RICO.

As the war progressed, the probability that Puerto Rico would come into the possession of the United States created an active demand for information regarding the commercial possibilities of that island. To meet this demand an exhaustive report was prepared upon the trade of Puerto Rico, showing the nature and value of the commerce transacted with each of the several foreign countries, and especially of that enjoyed with Spain and with the United States. The fullest possible statistical information was presented in regard to the commodities imported and exported, the character of the exports indicating in a measure the resources of the island, and that of the imports its requirements as a market for the products and manufactures of other countries. The statistics quoted regarding the island's trade were all procured from official sources, and as they had not previously been published in this country, the information they conveyed proved to be particularly timely. The numerous requests that were received for the bulletin on Puerto Rico indicated an extraordinary interest in this newly-acquired possession of the United States.

#### DATA FOR RECIPROCITY NEGOTIATIONS.

Mention has already been made of the time devoted to the preparation of data for the use of the special commissioner appointed to negotiate reciprocity treaties between the United States and other nations. During a period of more than two months the entire working force of the section was utilized for this purpose. The statistical matter prepared for the special commissioner embraced detailed statements of the tariff rates levied by certain foreign countries upon agricultural products imported from the United States, and also full statistics as

to the quantity and value of these imported products. The countries for which statements were furnished included France, Germany, Italy, and Spain, and also a number of British colonial possessions, as follows: The Bahama Islands, Jamaica, the Windward Islands, the Leeward Islands, Trinidad, Bermuda, Honduras, and British Guiana. The fact that nearly all of the statistical data required by the commissioner had to be converted from foreign denominations into United States equivalents added greatly to the labor involved.

#### PLANS FOR THE CURRENT FISCAL YEAR.

The section is at present engaged in the preparation of a report upon the trade of the Philippines. As the records of importation and exportation received from the islands are extremely meager, it has been found necessary, in order to present a comprehensive statement of the commerce that actually exists, to collate from the trade reports of the various countries dealing with the Philippines such statistics as they give regarding their respective transactions with the archipelago. This is not a task of small proportions, and its completion will probably require at least another month.

After the report on the Philippine Islands has been finished, it is proposed to prepare for publication a review of our foreign trade in agricultural products during the past fiscal year, contrasting the imports and exports of that year with those of the year preceding. This report will follow in general plan a similar one published a year ago.

Through the medium of the State Department the section is receiving a series of reports from our consular officers in foreign countries regarding the opportunities that exist in their respective districts for extending the use of American corn as an article of human food. The preparation of the data contained in these numerous reports will undoubtedly involve a large amount of labor, and this fact must be taken into consideration in devising plans for the current year.

The remarkable interest recent events have created as regards the development of our foreign commerce shows itself in the numerous inquiries upon this subject that are being received by the section. The demand for information regarding the trade possibilities of the newly acquired possessions of the United States is particularly active. Owing to the increased labor necessary to answer these inquiries, the time available for preparing publications has been greatly reduced, and if the growing demands upon the section are to be properly met, additional clerical assistance should be provided.



## REPORT OF THE LIBRARIAN.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE LIBRARIAN,  
*Washington, D. C., August 11, 1898.*

SIR: I have the honor to submit a report on the Library of the Department for the fiscal year ended June 30, 1898.

Respectfully,

W. P. CUTTER,  
*Librarian.*

Hon. JAMES WILSON, *Secretary.*

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## WORK OF THE YEAR.

### ADDITIONS TO THE LIBRARY.

I have the honor to report that during the fiscal year ended June 30, 1898, there have been added to the Library of the Department, by gift and purchase, and by the binding of periodicals, nearly five thousand volumes, making a total of over sixty thousand volumes in the Library. The notable addition of the library of the late Prof. F. von Baur, of Munich, Germany, has supplemented the collection of works on forestry in the Library, so that the collection is very complete.

### CATALOGUES.

The work on the card catalogue is progressing well, more than one-half of the collection being entered under author and subject. A complete catalogue of the forestry section of the Library is ready for the printer, and a catalogue of the chemistry section will soon be ready. Work is also being done on a complete list of the periodical sets in the Library, which will probably be finished during the present year.

### PUBLICATIONS.

In addition to the quarterly lists of accessions, there have been published two bibliographies of special subjects, which have proved very useful.

## USEFULNESS OF THE LIBRARY.

I am gratified to be able to say that the Library is finding quite extensive use among the teachers in the public schools and students in the science classes of the various educational institutions of the city. Such use does not interfere with the use by employees of the Department, and adds to the value of the Library to the public.

## RECOMMENDATION.

The increase in the number of books has rendered necessary the addition of shelving to accommodate 10,000 books. No further additions will be possible on the main floor of the Library, and provision must be made for more space very soon.

## REPORT OF THE CHIEF OF THE DIVISION OF FORESTRY.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF FORESTRY,  
*Washington, D. C., October 31, 1898.*

SIR: I have the honor to submit herewith a report of the work of the Division of Forestry for the fiscal year ending June 30, 1898, together with the plans for the work of the division for the coming year. My appointment as chief of the division did not take effect until after the close of the fiscal year. Consequently that portion of the report which covers the work of the past year was prepared at my request by Mr. Charles A. Keffer, whose relation to the division during that time was that of assistant chief.

Respectfully,

GIFFORD PINCHOT,  
*Forester, and Chief of Division.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

The work of the Division of Forestry during the year was largely a continuation of the work already under way. The principal subjects under consideration were: (1) Timber physics; (2) forest conditions; (3) biological studies; (4) tree planting in the plains.

#### TIMBER PHYSICS.

In compliance with your wishes, the investigations into the characteristics of our leading economic species of timber, heretofore conducted under the name of timber physics, have been brought to a conclusion. During the year no new tests were made, except a series on large beams, necessary to make our data complete. Much careful work has been done in the elaboration and tabulation of data previously obtained, and the results have been printed in Circulars Nos. 15, 18, and 19.

#### FOREST CONDITIONS.

During the year the chief of the division completed a preliminary survey of the forests of the Cascade Mountain region in Washington, on which to base a more thorough and systematic examination in the future. Mr. Fillbert Roth, a special agent of this division, acting in cooperation with the geological survey of Wisconsin, made an investigation into the forest conditions and interests of that State, the results of which have been published in Bulletin No. 16.



The Botanist of the Department, Mr. Frederick V. Coville, prepared a report on "Forest growth and sheep grazing in the Cascade Mountains of Oregon," based upon personal observation and study, which was printed as Bulletin No. 15 of this division. These two reports, presenting forest conditions and needs in widely differing regions, are of enduring interest and value.

#### BIOLOGICAL STUDIES.

The extensive investigations into the life history and rate of development of white pine have been brought to a conclusion during the year. The monograph on white pine is in press. The publication of this important monograph has been long delayed, owing to a lack of knowledge of the rate of growth of the species under different conditions throughout its economic range, which has been well supplied by the studies of Messrs. Roth, Mlodziansky, and others of the division staff. A technical report giving full details of measurements of white pine and deduced results of rate of development is also in the printer's hands. The final revision of the monographs on bald cypress and white cedar has been completed by Dr. Charles Mohr, and these reports are now ready for the printer. The monographs are similar in character to the same author's "Report on the timber pines of the Southern United States."

#### TREE PLANTING IN THE PLAINS.

The work of the year in experimental tree planting in the plains has had as its special feature the introduction of conifers into existing plantations and the establishment of conifer nurseries at the several stations. Three hundred and twenty-five thousand pines have been set at the eleven stations maintained by the division, and 300,000 additional have been distributed to responsible farmers throughout the plains region in quantities sufficient for plantations of 1 to 5 acres. The favorable conditions which prevailed generally throughout the West resulted in satisfactory growth, so far as reported. Arrangements for the propagation of conifers from seed to be furnished by the Department were perfected, which will result in a great reduction in the cost of stock.

During the year an illustrated bulletin on "Experimental tree planting in the plains" was issued.

#### PUBLICATIONS.

In addition to the publications noted above, there have been issued during the year a bulletin on "Osier culture," compiled by Mr. John M. Simpson, and circulars on "Age of trees and time of blazing determined by annual rings," "Recent legislation on State forestry commissions and forest reserves," and "Increasing the durability of timber." Bulletins on "A check list of the forest trees of the United States," by Mr. George B. Sudworth (a revision), and on "Measuring the forest crop," by Mr. A. K. Mlodziansky, are in press.

#### CHANGES AMONG THE PERSONNEL OF THE DIVISION.

After twelve years' honorable service, Dr. B. E. Fernow resigned his position as chief of the division, his resignation taking effect July 1, 1898, in order to accept the directorship of the newly organized

College of Forestry in Cornell University. Messrs. Roth, Neely, and Stück also severed their connection with the division during the year. The present chief was appointed in succession to Dr. Fernow.

### PLANS FOR THE ENSUING YEAR.

The first duty of the newly appointed chief of the division was to prepare plans of work for the coming year. These plans have been prepared with several definite objects in view, among which are: (1) To introduce in practice better methods of handling forest lands of private owners, including both wood lots and large areas chiefly held for lumber, and afterwards to spread a knowledge of what has been accomplished; (2) to assist the Western farmer to plant better trees in better ways; (3) to reduce the loss from forest fires, the reported amount of which reaches a yearly average of not less than \$20,000,000, (4) and, if future appropriations will permit the necessary investigations, to inform our citizens regarding the extent and value of new opportunities for forest enterprises in Alaska, Cuba, and Puerto Rico. These objects can be pursued only so far as appropriations will permit. The present resources of the division are utterly inadequate to meet the pressing and steadily growing demands already made upon it. The lines of work undertaken for the coming year are, in brief detail, as follows:

#### WORKING PLANS.

Since private forest lands exceed in area those of the Federal Government and the States combined, their preservation in productive condition is of vast importance to the nation. Practical assistance will be given to farmers, lumbermen, and others in handling forest lands under the conditions stated at length in Circular No. 21. In brief, these conditions are as follows: Working plans, with full directions for practical work, are prepared by the division for owners of wood lots without cost to them, for owners of larger tracts at the cost of traveling expenses and subsistence for the agents of the division while in the field, together with the necessary assistants, whom the owners must provide. In all cases the present interest of the owner is considered equally with the improvement of the forest. Applications for assistance under this plan have been received for forests covering nearly 1,000,000 acres, distributed through nineteen States, and working plans have been prepared and are in operation for more than 100,000 acres.

#### TREES FOR THE PLAINS.

The attempt to find the best trees to plant in the treeless agricultural regions is of vital concern to the farmers there. The first step should be a careful study of what has already been demonstrated by thirty years of tree planting, and on that foundation the inquiry can be safely established. In the meantime no further planting of commercial kinds of trees by the Department should be undertaken.

#### LUMBERING.

An attempt to introduce changes in methods of lumbering already established would be hazardous except for the fact that slight and inexpensive differences in ways of work are often very effective, both

for the good of the forest and for the good of the lumberman. Such changes are already in operation on more than 100,000 acres in the Adirondack forest, under the supervision of the Division of Forestry, as has been already mentioned.

Investigation is needed in the white pine lands of the middle West to find means of reproducing this most valuable tree and of protecting the young growth. Similar work is required in the Douglas fir (red fir) regions of the West. Historical and descriptive accounts of the progress and methods of lumbering in this country will be valuable, in order to reach a right conception of its needs and possible improvement in the future.

#### SPECIAL STUDIES OF TREES OF COMMERCIAL IMPORTANCE.

Our ignorance of the rate of growth and habits of our principal timber trees makes it important to extend studies of them without delay. In addition to the white pine, hemlock, red spruce, and the Southern timber pines, which have received some attention, the yellow poplar, black walnut, pencil cedar, bald cypress, and many other Eastern trees are pressing for study, while in the West, among others the Douglas fir, lodge-pole pine, sugar pine, giant cedar, coast redwood, and Western yellow pine deserve immediate attention. These are but a few of numerous trees upon which work should be begun at once. Work is in progress on the hemlock, loblolly pine, and pencil cedar. One of the most practical results of such studies is the answer to this question: Is it worth while to hold timber land of a given character for a second crop?

#### FOREST FIRES.

The nature and ways of action of forest fires and their effect on the composition and reproduction of forests have been very little studied. Such knowledge is so essential to the most effective work in preventing and fighting them that the absence of systematic attempts to collect it is to some degree a matter of surprise. It is proposed to prosecute investigations in southern California, where forest fires affect very seriously the success of irrigation, and are much dreaded by the local population; in Oregon, where the relation of fires to sheep grazing is most important; in the Olympic Mountains and other portions of Washington, where the loss from fire and consequent floods threatens to be as great as in any other region of the United States; in Montana, Colorado, and Wyoming, where immense damage is being done; in the region of the Great Lakes and the Adirondack Mountains of New York, where fire has the most vital influence on the supply of white pine, and in the Southern pine belt, where the question of forest fires is intimately connected with the production of naval stores and the future of the longleaf, perhaps the most valuable species of pine in the world. A study of forest fires in the past, with the object of ascertaining the progress of the loss they cause, with its nature and amount, is a necessary adjunct to the field work just mentioned. The work on forest fires has made some progress since the 1st of July in Washington, Montana, Wyoming, Colorado, Wisconsin, and New York, and the historical study is far enough advanced to indicate an average yearly reported loss from forest fires of at least \$20,000,000, to which the vast unreported loss must be added before the true total can be reached.



## COLLECTION OF PHOTOGRAPHS.

A suitable series of photographs of the forests of this country, with descriptions of each, does not exist. It is much needed, and will furnish most important material in the study of our forest resources. The work of collecting has begun.

## CUBA AND PUERTO RICO.

The forest resources of the islands of Cuba and Puerto Rico are constant subjects of inquiry by our citizens. It is strongly recommended that arrangements be made for an examination of them and a fully illustrated report. A trip of from two to three weeks in Puerto Rico and four to six weeks in Cuba during the winter, especially if military transportation be secured, would cost but little, and would yield a good reconnaissance knowledge of the timbers and forest resources of the islands. These rough studies should be supplemented later on.

## ALASKA.

The rapidly approaching development of Alaska makes it imperative to learn something more definite of its timber resources. Since the working season there is short and the need of information great, two parties should be in the field as early as possible in the spring of 1899.



## REPORT OF THE STATISTICIAN.

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U. S. DEPARTMENT OF AGRICULTURE,  
DIVISION OF STATISTICS,  
*Washington, D. C., October 1, 1898.*

SIR: I have the honor to submit herewith a report of the work of the Division of Statistics for the fiscal year ending June 30, 1898.

Respectfully,

JOHN HYDE,  
*Statistician.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

The collection and publication of information concerning the condition, acreage, and production of the principal products of the soil, and the number, value, and condition of farm animals have continued to constitute the principal work of the division.

### REPORTS PRINTED.

The total number of copies of the various publications of the division distributed during the year exceeded 1,500,000, in addition to which about 7,000 letters were written in response to requests for special statistical information that could not be supplied in printed form.

In addition to the crop-reporting work of the division special investigations have been conducted in relation to the consumption of commercial fertilizers, the changes in the rates of charge for railway and other transportation services, the cost of raising a bale of cotton, the production of sugar in the United States, the world's production and consumption of wool, and the application of the principle of cooperation to farming or for the farmer's benefit. Of these investigations, the two first mentioned were completed and their results made public during the fiscal year covered by this report. I desire especially to invite your attention to these various investigations as showing how large and important a field of usefulness lies open to the division aside from the work with which it is chiefly associated in the public mind and presumably in Congress.

### THE CROP REPORTING SYSTEM.

In the report of the Statistician for the fiscal year ending June 30, 1897, I dealt at some length with the subject of Government crop reporting, with special reference to the cumbrousness of the existing



method, and I strongly urged a reconstruction and simplification of the system in operation with a view to increasing the sense of responsibility on the part of the individual reporter and to facilitating the analysis and coordination in this division of the truly vast number of reports received from its correspondents from month to month.

The threefold recommendation I submitted included (1) a return to the former practice of having a salaried statistical agent in each State, who should be able to bring to the examination of the reports of his correspondents a sound judgment and a thorough familiarity with the general conditions and capabilities of the various sections of his State; (2) the making provision for some slight pecuniary acknowledgment of the services of a carefully selected corps of crop reporters in the different counties of the principal agricultural States; and (3), as a further means, not only of strengthening and unifying the statistical work of the Department, but also of bringing the Department itself into closer touch with the agricultural interests of the country, the appointment of five traveling inspectors, whose duties should include the periodic visitation of the State agents and county correspondents for the purpose of insuring a proper understanding on the part of those persons of the duties required of them, and of securing absolute uniformity of method in considering and reporting upon the condition of crops; the submission of reports based on the inspectors' own observations at critical periods or in special localities; the careful watching out for those sudden developments or insidious changes in the agricultural conditions of particular sections of the country which frequently have far-reaching economic results before their importance, if not their existence, comes to be fairly appreciated, and various other functions with which such officers might advantageously be intrusted in connection with the work of this great Department.

The fact that in the face of these recommendations Congress has seen fit to make a reduction in the appropriation for the work of this division has rendered it impracticable to put into effect more than one of the changes by which I had hoped to render the crop-reporting system of the Department of greater value to the country. The number of State agents has, however, been increased from 20 to 41, at an additional cost of \$8,000 per annum, and the voluntary crop-reporting system has been materially strengthened without any break in its continuity or change in its essential features. This last-named improvement has been accomplished, in part, by an increase in the number of correspondents, and to a larger extent by greater promptness and regularity in the transmission of reports and greater care in their preparation. Among the county correspondents, who numbered on the last day of the fiscal year 2,584, an increase of 13.5 per cent in the total number has been accompanied by an increase of 13.7 per cent in the average number reporting, while among the township reporters, who numbered 42,402 on the last day of the fiscal year, an increase of 6 per cent in the total number has been accompanied by an increase of 22 per cent in the average number reporting.

The best efforts of the division of statistics will continue to be directed to the improvement of its crop-reporting system, as one of the most important factors in its work. If what I may be permitted to call the raw material of its reports is of inferior quality, the fabric into which it is woven can be neither attractive nor durable.

## ALLEGED PREMATURE PUBLICATION OF GOVERNMENT REPORTS.

For several years past there have been in possession of certain operators on the different produce exchanges, from twelve to thirty-six hours in advance of the publication of the monthly crop reports of this division, statements relative to the condition of the crops that have been alleged to have been derived from official sources, and their frequently close correspondence with the official figures subsequently announced has seriously reflected upon the honor and integrity of the division. This deplorable state of things has been the subject of much serious consideration since the present Statistician entered upon the duties of his office. Without reflecting upon any member of the very efficient clerical force of the division, changes have been made in the handling of the returns that have made it practically impossible for anyone to anticipate the final official figures, and it is a matter of the very greatest satisfaction to the Statistician to be able to report that while claims as to the possession of advance information still continue to be made, the wide difference of the figures from those of the official reports stamps such claims as false and fraudulent, and that any future occasional coincidence can be shown conclusively to be purely accidental, the present organization of the clerical force of the division rendering any premature publication of the official figures absolutely impossible. The duty of the Statistician in the premises is so unmistakable that no reference would have been made to the subject but for the wide publicity that has been given to it and the general acknowledgment on the part of the commercial press that the evil so long complained of has at last been put an end to.

## ENLARGEMENT OF THE SCOPE OF INVESTIGATIONS RECOMMENDED.

In view of the widespread interest attaching to the statistics of wheat, the uncertainty that prevails as to the annual per capita consumption of that product, and the difficulty of obtaining absolutely reliable information concerning the amount produced from year to year, I respectfully recommend such an extension of the work of the division as shall enable the Department to speak with a greater degree of confidence and authority than it can now pretend to concerning the much-discussed food problem of the United States and the world at large. To this end, it is proposed, first of all, to establish a record of movement and visible supply. This would not only prove a valuable check upon the statistics of production, but it would also have a steadying effect upon the market, and would pave the way for an investigation of the consumption of wheat in certain typical communities that would be of the highest statistical and economic value. To the same end, I most earnestly renew my recommendation for the employment of five traveling inspectors, who should visit the principal agricultural regions after seed time, during critical periods of the growing season, and, finally, after harvest, reporting the results of their observations and investigations to the Statistician. I strongly recommend the selection of such inspectors from among the more experienced and capable members of the clerical force of the Division of Statistics, who would be disinterested and unbiased and familiar at once with the requirements of the Department and the weak points of its crop-reporting system. During the four or five months of the

year when their services as traveling inspectors would not be needed the employees detailed to this important service would be available for other official duties in the division. This plan would have a great advantage in point both of economy and of efficiency over any other method of periodic visitation that I deem feasible.

#### STATISTICS OF NEW TERRITORIAL POSSESSIONS.

The recent acquisition of territory brings under the dominion of the United States islands the products of whose soil are too considerable in volume, of too vital importance to the regions in which they are grown, and too likely to enter into competition with the products of other States and Territories not to be taken statistical cognizance of by this division, and I respectfully recommend that adequate provision be made for the establishment of an efficient system of crop reporting in all the islands brought or to be brought within the dominion of the United States.

#### THE STATISTICAL LIBRARY.

The statistical reference library now comprises 12,000 books and pamphlets. While it forms an integral part of the general library of the Department, it has been built up almost entirely through the efforts of successive Statisticians, and the fact that there is not a moment in the day when its various contents are not being consulted not only justifies but necessitates its continued segregation. I earnestly recommend that all publications of a statistical nature belonging to the Department be included in the statistical library, and that such an effort be made to still further enrich it as shall result in its becoming without doubt the most complete statistical library in the country.



## REPORT OF THE CHIEF OF THE BUREAU OF ANIMAL INDUSTRY.

U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF ANIMAL INDUSTRY,  
*Washington, D. C., September 24, 1898.*

SIR: I have the honor to transmit herewith a report of the operations of the Bureau of Animal Industry for the fiscal year ended June 30, 1898.

Respectfully,

D. E. SALMON,  
*Chief.*

Hon. JAMES WILSON, *Secretary.*

### WORK OF THE YEAR.

#### MEAT INSPECTION.

The increase of work in connection with meat inspection was very large during the year and required the appointment of a large number of employees. These were obtained upon certification by the Civil Service Commission, and have proved, as in the previous year, to be competent and satisfactory. Although the bureau force of employees is enlarged from year to year, as the appropriations for the inspection work will permit, the efficiency of the employees is also increased through the examination by the Civil Service Commission, and the bureau is thus enabled to maintain a thorough system of inspection.

A reference to the tables giving the number of animals inspected this year and for 1897 shows that the number has been greatly increased; yet it is still true that the appropriation for this bureau is not sufficient to permit of the inspection of all meat entering into interstate commerce, although the law contemplates that all should be inspected. It is true, however, this year as last, that all of the beef exported to Europe and the greater part of the pork and other meat products exported have been inspected in accordance with the law.

During the year meat inspection has been in operation at 135 abattoirs, as against 128 for the previous year, and in 35 cities, as against 33 in 1897.

The table following gives the number of inspections of animals before slaughter, made either in the stock yards or at the abattoirs, and shows the number inspected for official abattoirs and the number of inspections of animals for abattoirs in other cities and miscellaneous buyers; also the number condemned on this inspection at abattoirs and the number rejected in the stock yards. The number

of rejected animals slaughtered and the number of these condemned will be found in the table of post-mortem inspections.

*Ante-mortem inspections.*

Kind of animal.	For official abattoirs in cities where inspections were made.	For abattoirs in other cities and miscellaneous buyers.	Total inspections.	Condemned at abattoirs.	Rejected in stock yards.
Cattle.....	4,552,919	4,675,318	9,228,237	104	27,491
Sheep.....	5,706,062	4,322,195	10,028,257	741	9,594
Calves.....	241,062	227,107	468,199	67	2,439
Hogs.....	20,713,863	10,896,812	31,610,675	9,679	66,061
Total.....	31,213,966	20,121,432	51,335,398	10,591	105,585

A comparison with the figures for 1897 shows a gain for 1898 of 1,178,212 cattle, 1,983,932 sheep, 19,216 calves, and 6,043,931 hogs—a total gain of 9,025,291 animals. This is an increase over 1896 of 15,417,919 animals. The number of condemned animals at abattoirs was 3,275 fewer than in 1897, and the number rejected in stock yards was 27,247 greater.

The number of animals inspected at time of slaughter and the number of carcasses and parts of carcasses condemned are given in the following table:

*Post-mortem inspection.*

Kind of animal.	Number of inspections.			Carcasses condemned.			Parts of carcasses condemned at abattoirs.
	For abattoirs.	Animals rejected in stock yards.	Total.	For abattoirs.	Animals rejected in stock yards.	Total.	
Cattle.....	4,418,758	14,143	4,433,181	6,900	3,118	10,018	12,591
Sheep.....	5,496,904	4,753	5,501,657	2,606	961	3,567	257
Calves.....	244,330	825	245,155	206	138	344	52
Hogs.....	20,893,199	43,641	20,936,840	69,652	7,927	77,579	635,250
Total.....	31,053,171	63,662	31,116,833	79,364	12,144	91,508	48,180

*a* Includes 19,975 condemned on microscopic examination.

*b* Includes 5,902 condemned on microscopic examination.

In addition to the above, there were killed by city inspectors 1,785 cattle, 1,509 sheep, 192 calves, and 14,698 hogs which had been rejected in the stock yards by officers of the Bureau of Animal Industry.

The meat-inspection tag or brand was placed on 14,815,753 quarters and 968,014 pieces of beef, 5,448,477 carcasses of sheep, 217,010 carcasses of calves, 680,876 carcasses of hogs, and 394,563 sacks of pork.

The meat-inspection stamp was affixed to 4,433,569 packages of beef products, 5,163 packages of mutton, and 10,145,048 packages of hog products, of which 374,131 contained microscopically examined pork.

The number of cars sealed containing inspected meat for shipment to packing houses and other places was 18,631.

There were issued 35,267 certificates for meat products which had received the ordinary inspection. These covered exports comprising 1,256,716 quarters, 67,120 pieces, and 735,814 packages of beef, weighing 339,650,091 pounds; 5,163 packages of mutton, weighing 324,996 pounds; 39,212 hog carcasses, and 653,564 packages of pork, weighing 244,956,482 pounds.

The cost of this work was \$409,138.09, which makes an average of 0.8 cent for each of the 51,335,398 ante-mortem inspections, besides covering all the subsequent work of post-mortem inspection, tagging, stamping, etc.

The cost of inspection has been growing gradually less year by year. The average cost per head was  $4\frac{3}{4}$  cents in 1893,  $1\frac{3}{4}$  cents in 1894, 1.1 cents in 1895, 0.95 cent in 1896, and 0.91 cent in 1897.

For the purpose of comparison, the following table is given:

*Number of animals inspected before slaughter for abattoirs having inspection, 1891-1898.*

Fiscal year.	Cattle.	Calves.	Sheep.	Hogs.	Total.
1891.....	83,891				83,891
1892.....	3,167,009	59,089	583,361		3,809,459
1893.....	3,922,174	92,947	870,512		4,885,633
1894.....	3,862,111	96,331	1,020,764	7,964,850	12,944,056
1895.....	3,752,111	109,941	1,344,081	13,576,917	18,783,000
1896.....	4,050,011	213,575	4,710,190	14,301,963	23,275,739
1897.....	4,289,058	259,930	5,179,643	16,813,181	26,541,812
1898.....	4,552,919	241,092	5,706,092	20,713,863	31,213,966

#### MICROSCOPIC INSPECTION OF PORK.

The number of samples of pork examined was 2,802,846, of which 1,927,838 were from carcasses and 875,008 from pieces. The following table shows that better results are obtained by making the inspection in the carcass than when samples from cured meat are examined:

*Comparison of inspections from carcasses and from pieces.*

Samples.	From carcasses.		From pieces.	
	<i>Number.</i>	<i>Per cent.</i>	<i>Number.</i>	<i>Per cent.</i>
Class A.....	1,892,131	98.148	864,042	98.747
Class B.....	15,729	0.816	5,064	0.579
Class C.....	19,978	1.036	5,902	0.674
Total.....	1,927,838	100	875,008	100

The samples of pork submitted for microscopic examination were classified as follows: Class A, samples in which no sign of trichinæ, living or dead, or calcified cysts are found; Class B, samples in which degenerate trichina cysts are found, but in which the body of the parasite is not recognizable; Class C, samples in which recognizable bodies, living or dead, of trichinæ are found. All hogs belonging to the latter class must be condemned and disposed of according to section 20 of the regulations dated June 14, 1895.

The number of certificates issued for microscopically examined pork was 20,158, covering shipments aggregating 373,366 packages, weighing 120,271,659 pounds. Of this quantity, 698 packages, weighing 161,303 pounds, were exported to countries not exacting a certificate of microscopic inspection.

The cost of microscopic inspection was \$171,040.94, an average per specimen examined of 6.1 cents, or an average of 0.142 cent for each pound exported.

This cost per pound for the inspection of pork shows a remarkable



reduction from the cost in 1897, when it was 0.256 cent. The cost in 1896 was 0.264 cent; in 1895, 0.2 cent; in 1894, 0.248 cent.

The number of samples examined increased 49 per cent over last year, the expense increased 53 per cent, and the exports increased 176 per cent.

The following table shows the exports of microscopically inspected pork for the fiscal years 1892 to 1898, inclusive:

*Exports of microscopically inspected pork, 1892-1898.*

Fiscal year.	To countries requiring inspection.	To countries not requiring inspection.	Total.
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1892.....	22,025,698	16,127,176	38,152,874
1893.....	8,059,758	12,617,652	20,677,410
1894.....	18,845,119	16,592,818	35,437,937
1895.....	39,355,230	5,739,368	45,094,598
1896.....	21,497,321	1,403,559	22,900,880
1897.....	42,570,572	1,001,783	43,572,355
1898.....	120,110,356	161,303	120,271,659

#### INSPECTION OF VESSELS AND EXPORT ANIMALS.

The following table shows for the fiscal year 1898 the number of inspections of domestic and Canadian cattle and sheep for export, the number rejected, the number of American cattle tagged, and the number of each exported; also the number of horses, mules, and hogs exported under the supervision of the bureau inspectors. For comparison the statistics for the fiscal year 1897 are included.

*Number of inspections, exportations, etc., of American and Canadian live stock for the fiscal years 1897 and 1898.*

Kind of animal.	American.				Canadian.		
	Number of inspections.	Number rejected.	Number tagged.	Number exported.	Number inspected.	Number rejected.	Number exported.
1898.							
Cattle.....	859,346	1,438	418,694	a 400,512	19,397	5	19,392
Sheep.....	297,719	180	-----	b 147,907	29,497	38	29,459
Horses.....	-----	-----	-----	29,570	-----	-----	3,955
Mules.....	-----	-----	-----	221	-----	-----	-----
Hogs.....	-----	-----	-----	599	-----	-----	-----
1897.							
Cattle.....	845,116	1,565	410,379	c 390,554	13,136	12	13,124
Sheep.....	348,108	189	-----	d 184,596	23,289	72	23,217
Horses.....	-----	-----	-----	22,623	-----	-----	6,185
Mules.....	-----	-----	-----	100	-----	-----	-----
Hogs.....	-----	-----	-----	-----	-----	-----	-----

a Includes 15,929 exported from Chicago by way of Canadian ports.

b Includes 5,173 exported from Chicago by way of Canadian ports.

c Includes 3,501 shipped from Chicago by way of Montreal.

d Includes 2,231 shipped from Chicago by way of Montreal.

The number of certificates issued for exported cattle was 1,616, as against 1,563 for 1897. The number of clearances of vessels carrying live stock was 971, as against 954 in 1897.

The following table gives the number of cattle and sheep inspected

at time of landing by the inspectors of the bureau stationed in Great Britain, with the number and percentage lost in transit:

*Number and percentage of cattle and sheep inspected by bureau inspectors in Great Britain and number and percentage lost in transit.*

From—	Cattle.			Sheep.		
	Landed.	Lost in transit.		Landed.	Lost in transit.	
	<i>Number.</i>	<i>Number.</i>	<i>Per cent.</i>	<i>Number.</i>	<i>Number.</i>	<i>Per cent.</i>
United States .....	381,420	851	0.22	151,863	1,224	0.8
Canada .....	17,164	56	0.32	27,912	394	1.39
Total .....	398,584	907	0.23	179,775	1,618	0.89

This table shows an increase of 20,898 cattle and a decrease of 9,408 sheep when compared with the report for 1897. The number of head of cattle lost in transit in 1897 was 2,323, or 0.61 per cent, as against 907 head, or 0.23 per cent, for this year. The number of sheep lost in transit in 1897 was 2,676, or 1.39 per cent, as against 1,618, or 0.89 per cent, for this year.

The cost of the inspection of export animals, the supervision of Southern cattle transportation, and the inspection of animals imported from Mexico was \$101,210.55. It is estimated that half of this expense is on account of the export inspection, and, with this as a basis, the cost of inspecting the 548,419 domestic cattle and sheep exported was \$50,605.28, or 9.2 cents per head. The number of inspections made on these animals in this country was 1,157,065, and in Great Britain 533,283, making a total of 1,690,348, the average cost of each inspection being 2.99 cents.

Following is a statement showing the inspection of domestic cattle and sheep for export and the number exported for 1898 and previous years:

*Inspections and exports of domestic cattle and sheep, 1893 to 1898, inclusive.*

Fiscal year.	Cattle.				Sheep.		
	Number of inspections.	Number rejected.	Number tagged.	Number exported.	Number of inspections.	Number rejected.	Number exported.
1898 .....	859,346	1,438	418,694	400,512	297,719	180	147,907
1897 .....	845,116	1,565	410,379	390,554	348,108	189	184,596
1896 .....	815,882	1,303	377,639	365,345	733,657	893	422,603
1895 .....	657,756	1,060	324,339	324,299	704,044	179	350,808
1894 .....	725,243	184	360,580	363,535	135,780	-----	85,809
1893 .....	611,542	292	280,570	289,240	-----	-----	-----

#### SOUTHERN CATTLE INSPECTION.

During the quarantine season of 1897 there were received and yarded in the quarantine divisions of the various stock yards 35,317 cars, containing 972,224 cattle; the number of cars cleaned and disinfected was 35,280.

In the noninfected area in Texas 225,096 cattle were inspected for the identification of brands prior to removal to other States for grazing.

#### INSPECTION OF IMPORTED ANIMALS.

The number of animals imported from Mexico and inspected at the ports of entry along the boundary line comprised 177,772 cattle, 64,207 sheep, 104 swine, and 3,053 goats.

There were imported from Canada for slaughter, milk production, grazing, feeding, etc., and not subject to quarantine detention, 79,907 cattle, 184,352 sheep, 374 swine, 2,998 horses, 2 goats, 8 mules, 1 deer, and 6 buffalo, of which 385 cattle, 6,867 sheep, and 217 swine were for breeding purposes.

Below is a statement of the animals imported and quarantined for the prescribed period at the different quarantine stations:

*Animals imported and quarantined at different stations.*

Stations.	Cattle.	Sheep.	Swine.
Littleton, Mass. ....	1		
Garfield, N. J. ....	282	303	10
St. Denis, Md. ....	10		
Houlton, Me. ....	43	52	1
Eastport, Me. ....	1		
Island Pond, Vt. ....	13	8	
Beecher Falls, Vt. ....	89	50	
Newport, Vt. ....	108		
Richford, Vt. ....	16		
St. Albans, Vt. ....	62	96	
Rouse Point, N. Y. ....	26		
Ogdensburg, N. Y. ....	144		
Cape Vincent, N. Y. ....	51		
Buffalo, N. Y. ....	85		
Port Huron, Mich. ....	44		
Total.....	975	509	11

There were 2 dogs, 2 deer, 14 goats, and 6 camels at the Garfield station, making a total of 1,519 animals quarantined.

TO PREVENT DISSEMINATION OF SHEEP SCAB.

In order to prevent the dissemination of scabies, it was required that sheep intended for feeding or breeding purposes should be dipped before being permitted to leave the stock yards, if they were affected with the disease or had been exposed to contagion. Accordingly, 535,501 sheep were dipped under the supervision of inspectors of this bureau, various preparations being used for this purpose.

INSPECTION OF HORSES.

The appropriation for the coming fiscal year carries a provision "that live horses and the carcasses and products thereof be entitled to the same inspection as other animals, carcasses, and products thereof" named in the bill. In accordance therewith, regulations are being formulated to govern the work of inspection of horses at abattoirs and of export horses.

WORK OF THE BIOCHEMIC DIVISION.

During the past year the routine work of the biochemic division, in the preparation and shipment of tuberculin and mallein and of ink for use in stamping meat, has continued steadily, and demanded much time from the divisional force. During the winter and spring months tuberculin sufficient to inject about 5,000 animals is sent out each month, while a slightly less quantity is used during the summer. The ink used for stamping the meat continues to give satisfaction; the work is more easily performed and at the same time considerable money has been saved.



## EXPERIMENTS WITH HOG CHOLERA.

The experiments conducted in the fall of 1897 upon hog cholera and swine plague proved so encouraging that a special appropriation was made by Congress for the purpose of continuing the work during the present year. Owing to the late date of the passage of the bill making this appropriation available, the work has been somewhat delayed; besides it was necessary first to erect barns at the bureau station, and also to make the necessary purchases of animals and other material, in order to begin the experiments on a sufficiently practical scale. Material to inject about 1,000 animals was sent to the agent of the bureau in Iowa, where the first test is being made, and his reports already received indicate that about 80 per cent of the animals treated are saved, while the loss in the check herds is about 85 per cent. A full report of this test will find its proper place in the report for 1898.

On account of the time required to secure a supply of this serum, the quantity so far produced has not been sufficient to give the necessary data upon which to base definite conclusions, but the results from the use of the comparatively small amount so far distributed have been so gratifying that I deem it desirable to continue the work another year. The production of serum is being steadily increased, and in the course of two or three months a large and regular output will be assured. It remains only to test the remedy upon a sufficient scale and to perfect the method of procedure.

## ADDITIONAL HELP AND ROOM NEEDED.

The proper conduct of these experiments has very materially increased the work of this laboratory. While two assistants have been added to the force, there is still need of additional help. The increased duties of the laboratory employees make it absolutely necessary that more room be provided if good results are to be obtained. The working space is so crowded that it not only interferes with the rapid conduct of investigation of various kinds, but the excessive weight of desks, tables, cases, etc., on the floor has reached the limit of safety.

## GERMAN TOYS AND COLORED GOODS POISONOUS.

In connection with an examination of those imports coming from Germany which might be injurious to the health of our people, it was shown that toys and colored goods of German origin were poisonous. All of the highly painted German toys may be considered very dangerous to the health of the children of this country if the paint is sucked or chipped off and swallowed through any inadvertence.

## ESTIMATING NICOTINE IN SHEEP DIPS.

Some examinations of the tobacco dips used in connection with sheep scab indicate that the methods in common use for the determination of nicotine are very misleading. Several experiments have therefore been made to find an easy and satisfactory method for estimating nicotine, and one has been worked out which is both practical and of easy execution.

## OBSERVATIONS RELATIVE TO TUBERCULOSIS.

The study of tuberculosis, with reference to both men and animals, has been continued, and the reports received from a tuberculosis sanitarium, where the serum supposed to have curative properties for

tuberculosis has been used to some extent, indicate that in incipient stages of the disease this material is of considerable value. The results also indicate that further experiments in the line already begun should be continued, as there is a prospect of still more satisfactory results. An easy, convenient, and important method for staining and differentiating tubercle bacilli from other germs which might be confused with them has also been worked out in this laboratory.

A fact which should be emphasized and carefully considered in connection with investigations of this character is the salary paid to the individuals engaged in the study of bacterial products. These men are at all times exposed to the danger of contracting a dangerous disease which may destroy their usefulness throughout life. Under these circumstances, salaries commensurate with the high character of the work required and the dangers to which they are exposed should be paid.

#### WORK CONTEMPLATED.

It is contemplated by this division to undertake investigations relative to Texas fever, anthrax, and other diseases of animals.

#### WORK OF THE DIVISION OF PATHOLOGY.

##### DIPPING FOR TEXAS FEVER.

Experiments in the dipping of cattle with a view to destroying the ticks which spread the infection of Texas fever have been continued, and a substance has been found in which the cattle may be immersed without suffering any serious injury, and which will destroy all the ticks on an animal in a single dipping. This is great progress over last year's experiments, as it was then considered absolutely necessary that cattle should be dipped twice before it would be safe to send them into any territory where cattle are susceptible to Texas fever. The preparation in which the cattle are dipped is a light lubricating oil containing dissolved sulphur. During the summer experiments have been made with a view to ascertaining whether this method of treating cattle could be carried out on a large scale, and for this purpose several train loads of cattle have been dipped at Fort Worth, Tex., and shipped to various places north of the quarantine line. Two train loads of cattle, consisting of about 500 head, were sent to the northern part of Illinois, where they were placed in pastures with susceptible cattle, in order to ascertain whether the dipping had rendered them safe against transmitting the fever. The experiments have proved to be a success, in so far as all of the ticks were destroyed on the dipped cattle and that no disease was transmitted by them. About 1,000 head have also been dipped with perfect success at Mammoth Spring, Ark. Preparations are now being made to adopt the dipping method generally, by means of which the cattle from the infected districts may be shipped north of the quarantine line during the entire year, while they are at present restricted by quarantine during ten months of the year. The importance of this measure can hardly be overestimated, and is considered by prominent stockmen and farmers to be worth millions of dollars, both to the cattle raisers below the quarantine line and to the cattle feeders and grain producers north of the line.

## BLACKLEG INVESTIGATIONS.

The preparation and distribution of blackleg vaccine have been continued throughout the year, and the demand for the vaccine has increased very much. More than 355,000 doses have been distributed, and the reports sent in by the recipients of the vaccine show that the annual losses from blackleg have been reduced from an average of from 10 to 20 per cent to less than 1 per cent. This means a saving of at least \$500,000 worth of cattle, and when all stock owners become familiar with the method and it is adopted throughout all the cattle-raising districts where blackleg prevails it will not alone save millions of dollars, but also tend to eradicate the disease completely.

## RABIES.

In the course of the year a number of supposed cases of rabies in dogs have been brought to this laboratory for determination. In some cases the dogs had bitten one or more persons, and it was consequently of great importance to determine whether the animals were suffering from rabies or not. In two cases it was proven that the dogs had been suffering from rabies and the health officer of the District was notified to that effect, and the five people which had been bitten by these dogs received the antirabic treatment of Pasteur.

## MISCELLANEOUS WORK.

The usual routine work of examining pathological specimens sent to the bureau from veterinary inspectors and private parties has been continued, and a number of outbreaks of infectious and contagious diseases among the domesticated animals in the vicinity of Washington City have been investigated and the owners advised as to the proper care and treatment of the animals.

## WORK OF THE DAIRY DIVISION.

The general survey of the condition of the dairy industry of the country at large, which was begun upon the organization of the division, has been continued, together with inquiries as to special branches, such as the milk supply of cities and large towns. Some reports have been printed and others are in hand awaiting revision and publication.

The collection of dairy data in general continues, with a view to its proper arrangement and future use in the form of circulars of information, popular bulletins, and the like. So far as the clerical force of the office permits the material collected has been indexed for ready reference.

The routine work of the office constantly increases, including general correspondence, calls for specific information, and the preparation of manuscript for publication.

During the year there have been published two bulletins and one circular prepared in the division, besides contributions to the Yearbook of the Department and to the Annual Report of the Bureau, in all comprising 284 printed pages.

The chief and assistant chief of the division have visited during the year centers of dairy interest in twenty-one States and collected information for future use. In order that the Department might be represented at as many as possible of the annual conventions of State dairy associations and similar organizations, Mr. John H. Monrad, of



Illinois, was appointed temporarily as a special agent of the division, and assisted in attending public dairy meetings. In all, twenty-four States were visited and dairy meetings attended in nineteen of them. In this way, officers and employees of the division have been enabled to meet hundreds of the representative men connected with this industry in various parts of the country, and to establish relations which will be of material future benefit to the general work.

#### BUTTER SHIPMENTS TO GREAT BRITAIN

The experimental exports of butter by this bureau to Great Britain, which were commenced in the spring of 1897, and partially reported upon a year ago, were continued until the close of the active creamery year of 1897 and resumed at the opening of the season of 1898 upon an enlarged scale. These exports have constituted the principal current work of this division during the fiscal year now reported, and have involved much detail, occupying the greater part of the time and attention of the office force. A complete report of the operations during the commercial year of 1897 has been prepared and is ready for publication in the Annual Report of the Bureau for 1897-98.

Without anticipating the results of the present (or second) season of these trial exports, it can now be confidently stated that much additional information has been obtained in the line desired, and a decided gain is evident in the favorable impression made by butter of the first quality from creameries in the United States upon the best class of the butter trade in London and Manchester.

An exhibit in the nature of an object lesson, illustrating the component parts of the various products and by-products of the dairy, has been recently prepared, and is included in the display of the Bureau of Animal Industry at the Trans-Mississippi and International Exposition, now in progress at Omaha, Nebr.

#### PROPOSED LINES OF WORK FOR 1898-99.

It is proposed that the work of the dairy division for the fiscal year 1898-99 shall include continuation of the different lines of effort reported as receiving attention during the years previous and still incomplete.

As already indicated, a large part of the energies of the division will be required for the experimental exports of butter, to which some trials with cheese and eggs, and perhaps dressed poultry, may be added. Material extension of these trial exports, in frequency, quantity, and variety of new markets, is made possible by the provisions incorporated in the current appropriation bill for this Department, in accordance with last year's recommendations, and by which the net proceeds of the sales of the products purchased for experimental export are available for a continuation or repetition of such exports.

It seems expedient to continue the weekly experimental exports of butter in progress during the summer of 1898 through the autumn and the following winter, in order to complete the trial of a full year's offerings in the market of Manchester, if not also in London.

Meanwhile it is proposed, by correspondence and the services of special agents, some voluntary, to investigate the prospects of trade in the dairy products of the United States, on the islands of the Pacific, Japan, and China, and also in the West Indies and South America. It is not unlikely that such inquiries will render it desirable to make experimental exports in those directions before the close

of the present fiscal year and during the next one. An appropriation similar to the one now available is therefore to be desired for the new fiscal year.

It is expected to prepare, in part, during the current year, for the proper presentation of the dairy interests and products of the United States at the coming Paris Exposition.

#### RECOMMENDATIONS.

The following recommendations are respectfully made for the fiscal year ending June 30, 1900:

(1) A sufficient appropriation for extending and developing foreign markets for dairy products of the United States, under provisions similar to those applying to the funds now available for this purpose. The reasons for this have been already stated.

(2) That legislation be sought by which the existing system of Government inspection and certification of meats and meat products for export may be extended (with suitable modifications) to include butter, cheese, and condensed milk for export from the United States.

Reasons for such new legislation were given a year ago, as follows:

The combined efforts of the Government and commercial enterprise may succeed in the early establishment of a high reputation for American butter in desirable foreign markets; but as soon as accomplished, this becomes liable to be destroyed by the cupidity of those who, trading on this reputation, flood the same market with butter of low grade, yet still entitled to export and sale as "produce of the United States." This will disgust merchants and consumers alike and reverse the reputation of our butter, just as the fine market in Great Britain for our cheese was recently ruined by the quantity of low-grade and counterfeit cheese which was exported without being marked to show its true character. The remedy seems to lie in extending and adapting the provisions of law regarding the inspection of meats exported from this country so as to make them apply to butter and cheese. The brands of "pure butter" and "full-cream cheese" should then be affixed by United States inspectors to such products only as are of a fixed minimum standard of quality. Such precautions, duly legalized and properly executed, would place the good butter and cheese of this country in foreign markets under the identifying label and guaranty of the United States Government, leaving similar merchandise of lower grade to find a place for itself upon its own merits. It should be borne in mind that dairy products of Denmark and Canada, which are the chief competitors of the United States in the markets of Great Britain, bear the inspection certificate and guaranty of quality from their respective Governments and thereby maintain a great commercial advantage.

Such a system of inspection is much desired by the most reliable exporters, and the proposition has met with decided approval wherever considered by fair-minded, interested parties.

(3) That the estimates for the Bureau of Animal Industry be made to include \$8,500 for "Salaries" and \$20,000 under "Salaries and expenses," to be definitely set apart for this division, with the expectation that it will all be needed and used. (This besides any special provision for experimental exports of perishable products other than dairy products which may be ordered supervised by this division.)

#### ERADICATION OF SHEEP SCAB.

In the report for 1897 it was noted that experiments were being made by the bureau with different sheep dips for the purpose of determining which is the most efficacious and at the same time least injurious to the animal. These experiments were concluded, and the results appear in an exhaustive article entitled, "Sheep scab: Its nature and treatment," in the Annual Report of the Bureau of Animal Industry for 1897, mentioned elsewhere in this report. In addition

to the character of dips, this article gives a full history and description of the mite causing common sheep scab and also descriptions of the various kinds of apparatus used in dipping.

Inspectors of the bureau have been zealous in enforcing Order No. 5, relative to the transportation of sheep having scab, which is as follows:

TRANSPORTATION OF SHEEP AFFECTED WITH SCABIES.

U. S. DEPARTMENT OF AGRICULTURE,

OFFICE OF THE SECRETARY,  
Washington, D. C., June 18, 1897.

*To the Managers and Agents of Railroads and Transportation Companies of the United States, Stockmen, and Others:*

In accordance with section 7 of the act of Congress approved May 29, 1884, entitled "An act for the establishment of a Bureau of Animal Industry, to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," and of the act of Congress approved April 23, 1897, making appropriation for the Department of Agriculture for the fiscal year ending June 30, 1898, you are hereby notified that the contagious disease known as sheep scab, or scabies of sheep, exists among sheep in the United States, and that it is a violation of the law to receive for transportation or transport any stock affected with said disease from one State or Territory to another, or from any State into the District of Columbia, or from the District into any State. It is also a violation of the law for any person, company, or corporation to deliver for such transportation to any railroad company, or master or owner of any boat or vessel, any sheep, knowing them to be affected with said disease; and it is also unlawful for any person, company, or corporation to drive on foot or transport in private conveyance from one State or Territory to another, or from any State into the District of Columbia, or from the District into any State, any sheep, knowing them to be affected with said disease. All transportation companies and individuals shipping, driving, or transporting sheep are requested to cooperate with this Department in enforcing the law for preventing the spread of the said disease. Inspectors of the Bureau of Animal Industry are directed to report all violations of this act which come to their attention.

In order more effectually to accomplish the object of the above-mentioned laws, it is hereby ordered that any railroad cars, boats, or other vehicles, which have been used in the transportation of sheep affected with said disease, shall be immediately cleaned and disinfected by the owners or by the transportation companies in whose possession said cars or vehicles may be at the time the animals are unloaded, by first removing all litter and manure which they contain, and then saturating the woodwork with a 5 per cent solution of crude carbolic acid in water. Inspectors of the Bureau of Animal Industry are directed to see that this order is carried into effect.

JAMES WILSON, *Secretary.*

The information which is now available for the public is sufficient to enable anyone to cure this disease with a minimum of trouble and expense. There will hereafter be no excuse for those who claim that they are unacquainted with the nature of the disease or with the methods of treatment.

AGRICULTURAL ATTACHÉ AT BERLIN.

The tendency has been growing in Germany to assume that all diseased or unwholesome meat is of American origin. The Department of Agriculture having certified, through the inspection of the Bureau of Animal Industry, that all pork shipped to Germany is free from trichinæ, and produced from healthy animals, the time had arrived when it became necessary to learn the truth in the matter, in order, first, to correct the error, if it existed, in the system of microscopic inspection conducted by the bureau, or, second, to deny authoritatively



the charge. Accordingly, Dr. Ch. Wardell Stiles, zoologist of this bureau, was commissioned as agricultural attaché of the American embassy at Berlin in the latter part of March, with instructions to trace to a conclusion every such rumor or charge of German origin. The account of his work will necessarily appear in the report for the fiscal year 1899; and in that report he will be able to show that in many of the cases there is no trichinæ infection, and that in others where it has existed it was not of American origin or had not been certified as microscopically inspected.

It would be rash to assert that there could have been no oversight in the inspection of 120,271,659 pounds of pork, which was the amount inspected last year, but it is certain that such errors are reduced to the minimum; and the purpose of sending Dr. Stiles abroad on this mission is to both reassure the American people and to convince the German people so far as possible that the most painstaking efforts are made by the bureau to inspect all pork exported to Germany, and that our microscopic inspection is as rigid and safe as that made by any country.

#### PUBLICATION WORK.

A list of the publications of the bureau appear in the report of the chief of the Division of Publications. On March 1 a clerk was appointed to have special charge of the editorial work of the bureau. This character of assistance has been needed for some time, as the time of the chief of the bureau and the divisional chiefs was wholly consumed in executive work or pressing investigations. One of the first duties of this assistant was the preparation of the Annual Report of the Bureau for the fiscal year 1897. For ten years previous to 1897 the reports of the bureau have been issued biennially, owing principally to lack of time to compile them, but it is proposed hereafter to issue one each year as the law authorizes. The report for 1897 was late in reaching the printer, but it will soon be issued. Its principal contents are the usual report of the chief of the bureau to the Secretary; a review of the contagious diseases of animals in Europe; an exhaustive article on the nature and treatment of sheep scab; the State and Territorial laws relative to contagious diseases of animals not published heretofore in the reports of the bureau, and a complete collection of the dairy laws; also the orders issued by the bureau since its organization.

The work on the Annual Report of the Bureau for 1898 is already well in hand.

An index is being made, which will embrace not only all of the publications of the bureau, but all documents of the Department which relate in any way to animal industry. This is being prepared as time can be spared from editorial work, but it will probably be ready for publication before the end of the fiscal year 1899.

#### NEEDS OF THE BUREAU.

In the report for last year attention was directed to the importance of an experiment station, to be the property of the Department, and also of greater laboratory facilities. The conditions have not been changed for the better, while the demand becomes more imperative. If these matters could receive the favorable action of Congress the work of this bureau would be greatly facilitated and the interests of public economy be subserved at the same time.



## REPORT OF THE CHIEF OF THE WEATHER BUREAU.

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U. S. DEPARTMENT OF AGRICULTURE,  
WEATHER BUREAU,  
*Washington, D. C., September 19, 1898.*

SIR: I have the honor to submit a report of the operations of the Weather Bureau during the fiscal year that ended June 30, 1898.

Respectfully,

WILLIS L. MOORE,  
*Chief of Bureau.*

Hon. JAMES WILSON, *Secretary.*

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### WORK OF THE YEAR.

#### NEW WORK AND SPECIAL INVESTIGATIONS.

##### EXTENSION OF WEST INDIAN HURRICANE SERVICE.

During the latter part of the fiscal year it became apparent that the methods of gathering information of the approach of West Indian hurricanes, which served so admirably when warnings for the Gulf and Atlantic coasts only were issued, were wholly inadequate for a service that should cover the waters of the West Indies, in which upward of 200 naval and transport vessels of the United States were operating. The presence of this large fleet in the hurricane region made it imperative that precautionary measures, looking to its safety in time of severe atmospheric disturbances, be adopted at once. Accordingly, a bill was drafted and submitted to Congress on June 16, 1898, authorizing the bureau to establish and operate observing stations throughout the West Indies and along the shores of the Caribbean Sea. The provisions of the measure were incorporated in the general deficiency bill, which, it will be remembered, did not become law until after the close of the fiscal year that ended June 30, 1898.

At that time, however, arrangements had been made to establish stations for making meteorological observations and displaying hurricane signals at the following points: Kingston, Santiago de Cuba, Santo Domingo, St. Thomas, Barbados, Port of Spain, Curaçoa, and Barranquilla. At the above-named places observations will be made twice daily and cabled to Kingston and the central office in Washington. It is expected that twice-daily observations will also be cabled from Martinique through the cooperation of the French meteorological service of that island.

The Weather Bureau will receive, when the West Indian service is fully established, twice-daily telegraphic reports, not only from the stations above named, but also from Habana, Nassau, Vera Cruz, Tampico, Coatzacoalcos, and Merida through international comity, and the



voluntary cooperation of private persons. For daily reports from Habana our heartiest acknowledgments are due to Prof. Louis G. Carbonell, superintendent naval service of the Antilles; from Nassau, to his excellency Sir Ambrose Shea, governor of the Bahamas; from Vera Cruz, Tampico, and Coatzacoalcos, to the Mexican Telegraph Company; from Merida, to a private observer, Señor Felix Gomez Mendicuti, C. E. The action of Professor Carbonell in forwarding daily weather reports from Habana during the period of hostilities between Spain and the United States is exceptionally gratifying to the officials of the bureau, as it must also be to scientists the world over.

An official of the Weather Bureau recently visited the three stations of the Mexican Telegraph Company, and as a result the system of observation at these stations has been brought into close harmony with our own.

Thus it will be seen that ample provision has been made to extend the network of existing stations to the southward, so as to include all of the dangerous waters of the West Indies, the Caribbean Sea, and the Gulf of Mexico.

Although the protection of our naval forces was the primary object in the extension of the storm-warning system to the West Indies, other considerations of scarcely less importance made the step a wise and beneficent one. First and foremost of these was the very material strengthening of the storm-warning system of the Gulf and South Atlantic coasts that would result from an extension of observing stations to the northern coast of South America; second, the improvement in the existing service that would follow the substitution of skilled observers for special agents in the West Indies; and, finally, the need of an efficient storm-warning service for the benefit of commercial interests throughout the West Indies and the shores of the Caribbean Sea.

If, as now seems probable, the exigencies of war permit the removal of the greater part of the fleet from West Indian waters, the meteorological service will still serve a useful purpose in the protection it will afford to the growing commerce of that very extensive region.

#### METEOROLOGICAL SERVICE OF THE REPUBLIC OF MEXICO.

I am informed by Señor Mariano Bárcena, director of the Central Meteorological and Magnetic Observatory of Mexico, that steps have been taken to thoroughly equip about thirty stations in the Mexican Republic with meteorological instruments of the most approved pattern, and to establish a meteorological service similar to our own, at the earliest practicable date. An exchange of reports between the two services that will be mutually advantageous, especially as regards the approach of West Indian hurricanes and "northers" in the Gulf of Mexico, will doubtless be effected.

#### ESTABLISHMENT OF ADDITIONAL OBSERVATION STATIONS IN THE ARID AND SUB-ARID REGIONS OF THE WEST.

The places of observation in the arid and subarid regions of our country have been so widely separated hitherto that it has not been possible to secure a perfect survey of the distribution of temperature and pressure, the conditions so essential to the making of accurate forecasts, not only for those regions, but for the extensive area farther

to the eastward. On the recommendation of the Secretary of Agriculture, an appropriation was made by the last Congress for an increase in the number of stations in the above-named regions. Provisions have already been made for the installation and equipment of stations at Kalispell, Mont.; Boise, Idaho; Mount Tamalpais, Cal.; Flagstaff, Ariz., and Fort Worth, Tex. Arrangements have also been made for the establishment of additional stations in the South and Central valleys, as follows: Meridian, Miss.; Macon, Ga.; Lexington, Ky.; Elkins, W. Va.; Evansville, Ind., and Escanaba, Mich. The additional stations thus provided for will not only assist in the development of agricultural and industrial interests in the respective States in which they are located, but will also be of material benefit in improving the warnings and forecasts, especially for the regions west of the Rocky Mountains.

#### INTERNATIONAL CLOUD OBSERVATIONS.

The series of observations undertaken in cooperation with the International Cloud Committee, extending over one complete year, was concluded on June 30, 1897. They embraced observations on the height, azimuth, and velocity of motion of clouds at Washington as a primary station, and at 14 secondary stations in the States east of the Rocky Mountains, except a half year at Baker City, Oreg. The computation and the discussion of the observations have been going on during the past year, and are so far advanced that it has been possible to prepare several chapters of the final report. It is hoped that this portion of the work may be completed by the end of the year 1898.

Among the results obtained in connection with these observations may be mentioned, the construction of a fundamental set of constants and formulæ in the barometry and thermodynamics of the atmosphere; the application to the reduction of the pressures on the Rocky Mountain Plateau of some new data; the delineation of the great atmospheric currents in several levels above areas of high and low pressure, respectively; the construction of the purely cyclonic and anticyclonic components which indicate quite clearly the structure of storms; the distribution of the eight types of clouds in height and the velocity of their movement in high and in low areas, respectively; a careful discussion of the vertical gradients of temperature, humidity, and pressure, besides many minor points of scientific interest and value.

#### AERIAL WORK.

The work of producing a thoroughly satisfactory kite was begun in the latter part of 1895. The early experimental work naturally took a wide range. Various forms of kites were devised and thoroughly tested, and many valuable laws relating to the strength and efficiency of kites were developed. At the date of last report a fairly satisfactory kite had been developed, but much still remained to be done in order to make the appliances and devices improvised during the experimental work suitable for permanent use in the hands of observers of only average skill and experience. The kite finally adopted for practical work was an improved form of the Hargrave cellular type, both theory and practice having indicated the general superiority of this type over all others where power, efficiency, structural strength for a given weight, and durability are to be considered. A popular idea prevails that any one possessed of a few materials and a little ingenuity can construct a thoroughgoing kite. This is not true as

regards the present Weather Bureau kite. The size and construction of every detail has been worked out with reference to the several strains at the different points, securing thereby the maximum strength with the minimum weight. Another desideratum of not less importance is a device that will enable the kite to automatically adjust itself in all winds so as to pull a moderate amount only. This result has been secured to a greater degree in the Weather Bureau kite, it is believed, than in any form yet described. While there is still need of improvement in the present design, it is doubtful if such can be secured until we understand more completely than at present the precise nature of the sheltering effect the forward cell exerts upon the rear cell. This and other important details still remain obscure and undeveloped.

Little or nothing was done during the past year to remove these obscurities, since the whole time was occupied in preparing for practical work. Briefly stated, the latter consisted in perfecting a complete working outfit of aerial apparatus based on the results of previous experimental work. Little difficulty was experienced in constructing a satisfactory reeling apparatus with its dynamometer, measuring dial, and graduated arc. Likewise the improved nephoscope, devised by Professor Marvin in 1896, answered satisfactorily as an alt-azimuth instrument. A suitable form of automatic register for recording temperature, pressure, humidity, and velocity of the wind was not, however, to be had of the manufacturers of meteorological instruments. A form of instrument had previously been devised, but it was not satisfactory in all respects. Under these circumstances a wholly new form of kite meteorograph recording four elements, viz, wind velocity, temperature, pressure, and humidity, was devised by Professor Marvin. The instrument complete weighs 2.1 pounds. A special construction was adopted for the thermometers, securing an unusually high degree of sensitiveness. The thermometers are, in fact, nearly or quite as sensitive as our standard mercurial thermometers. This quality is especially necessary in a kite meteorograph since the elevation of the kite is almost constantly changing, often considerably, and a sluggish thermograph will not show the temperature at a given spot correctly.

Another important feature in the improved meteorograph consists in the exposure of the thermometer bulb and hygrometer. These are placed inside a long tube,  $2\frac{1}{4}$  inches in diameter, open at both ends, and so arranged upon the kite that the wind blows with full speed directly through the tube, thereby affording not only the most perfect ventilation of the instruments contained, but screening them at the same time from radiation. The tube is wholly inclosed within the case of the instrument, from which it is insulated in the heat sense by plates of ivory and rubber. Arrangements of this character have repeatedly been shown to be necessary in order to secure accurate results in the free air.

At the date of last report it was hoped to establish at least 20 stations during the coming fiscal year. We have been able, however, to completely equip but 16, as follows: Cairo, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Dodge City, Kans.; Dubuque, Iowa; Duluth, Minn.; Fort Smith, Ark.; Knoxville, Tenn.; Lansing, Mich.; Memphis, Tenn.; North Platte, Nebr.; Omaha, Nebr.; Pierre, S. Dak.; Sault Ste. Marie, Mich.; Springfield, Ill., and Topeka, Kans. Washington, D. C., was already equipped at the beginning of the year.

The observers chosen for the work were, with three exceptions,



drawn from the list of eligibles on the register of the Civil Service Commission, the three additional men being drawn from the force at stations. All these men were called to Washington and given a practical course of instruction in the art of flying and managing kites. The whole period of instruction extended from the 17th of March to the 18th of April, but the same observers were not in attendance for the whole period.

The contractor for furnishing the meteorographs was seriously delinquent, and caused great delay in beginning the observations; many stations made ascensions without meteorographs for two or three weeks, and all stations were not fully equipped until the first week in June.

If each station had made an ascension daily during June, 510 ascensions could have been made; whereas, 278 actual ascensions were made, in all of which the elevation attained exceeded 1,000 feet. Considering the great natural obstacles in this work, and the fact that June is one of the least windy months of the year, we are disposed to regard the number of ascensions made as, on the whole, a satisfactory percentage (54) of those possible. It is regretted that similar data as to the percentage of ascensions that can be made during windy seasons of the year are not also available at this time.

The standard kite employed contains about 68 square feet of supporting surface, and only one of these kites is required at a time. The practice adopted by some investigators of flying several small kites in tandem in order to gain power enough to sustain instruments proved to be much less satisfactory, on the whole, than our own practice of using one large kite. The latter is far easier to manage in critical situations, and also under unfavorable conditions of flight; it is, moreover, more efficient. Originally each station was supplied with two of the large kites. Subsequently additional kites were sent out in a few cases to replace those wrecked and rendered completely unserviceable by accidents. As yet too short a time has elapsed to furnish data for a satisfactory estimate of the average life of a kite; this may prove to be something like six months, while we are not yet able to determine the probable losses of wire and meteorographs. The practice adopted of suspending the meteorograph within the kite structure completely shields it from injury in ordinary work with the kite. Notwithstanding numerous small and a few serious accidents to the kite itself, the meteorographs have thus far completely escaped injury, often in a seemingly remarkable manner. In one case, with 12,000 feet of wire out, the kite was struck by lightning, fusing the wire and setting the kite adrift. Both the kite and the meteorograph were discovered the second day afterwards 20 miles away. The kite was but little injured, and the meteorograph was still running. In another case the kite broke away at great elevation and soon disappeared from sight. The most careful search failed to discover a trace of its whereabouts, and it was given up as lost, either in the waters of adjacent lakes or the somewhat more distant Canadian forest. About three weeks later the meteorograph was found and returned to the Weather Bureau, having suffered only such injury as resulted from the long exposure to the weather.

As a result of the year's work 16 stations have been completely equipped, and the observers have already had the experience necessary to fit them for the more onerous work of the fall and winter months. We are now in a position, so far as means and appliances are concerned, to obtain a complete series of observations. It is yet

too early to express an opinion as to the value of the observations already secured in the practical work of the bureau. The observations contain much information that is new and of practical importance, aside from their value in making weather forecasts.

The problem of connecting barometric observations made on the Rocky Mountain plateau with those of low levels on either side will, in all probability, receive substantial aid from kite observations. The chief difficulty in this problem heretofore has been a lack of exact information respecting the temperature and moisture of the air column that would exist between the plateau station and sea level if the plateau were removed. It happens not infrequently that the temperatures a mile or more above sea level are not much less than on the plains in the same latitude near sea level. Applying a correction to these temperatures based on the present accepted rate of decrease of temperature with altitude gives a result generally too high to correspond with temperature on each side in the same latitude at sea level. It is expected that the kite observations will add largely to our knowledge of the temperature gradients aloft, and thus contribute to the solution of the problem of reducing barometer readings on the plateau to sea level. Anything that will remove the uncertainty that at times exists in our present reductions to sea level will be a distinct gain in the forecast service.

The kite work of the present year, as in the past, has been conducted under the personal supervision of Prof. C. F. Marvin, to whose skill and inventive genius much of the success that has attended our efforts is due.

#### METEOROLOGICAL CHART OF GREAT LAKES.

During a personal inspection of Weather Bureau stations on the Great Lakes in the summer of 1897, I became convinced that the usefulness of the bureau in that region could be greatly increased. One of the measures adopted with that end in view was the issue of a monthly chart to vessel masters, the first issue of which was mailed on September 27, 1897. The chart shows, among other things, the lake ports at which storm warnings are displayed, the localities in port where information respecting the weather can be obtained, the regions of fog, the prevailing winds, and other statistical information respecting the winds and weather on the lakes.

The collection and publication of data relating to fog frequency has been productive of interesting results. It has been shown that fog prevails in mid lake more frequently than on shore, and that some parts of the lakes are more liable to fog than others. Eventually it will be possible to map the areas of greatest fog frequency on the lakes for the guidance of lake captains. Whether it will be possible to predict the occurrence of fog on the lakes is a question the bureau is not yet ready to answer.

#### LOSS OF FARM PROPERTY BY LIGHTNING.

A number of inquiries have been received during the last few years relative to the frequency of thunderstorms. Several correspondents of the bureau hold to the view that there has been a perceptible increase in the number of storms and fatalities by lightning stroke within a comparatively short period. This view is also held by insurance companies which include lightning risks in their business, and

statistics have been adduced in support of this contention. Thus, to quote a single illustration, a well-known farmers' mutual fire-insurance company that insures isolated farm property, mainly in central and northern New Jersey, paid in losses by lightning during the six years, 1882-1887, \$24,388; during the six years, 1892-1897, \$62,153.

The following illustrates the variation from one year to the next: The mutual fire-insurance companies of Michigan sustained a loss of \$37,563.64 in 1895, due to lightning, of which there were 316 strokes. In the following year a loss of \$143,841.26, on account of 1,509 cases of lightning stroke, was sustained.<sup>1</sup> Such a variation from year to year is perplexing alike to the insurer and the insured. The statistics of thunderstorms for Michigan, collected by the Weather Bureau, show that there were 14 per cent more storms in 1896 than in 1895, while the number of lightning strokes, as shown by reports received by the commissioner of insurance for Michigan, increased 377 per cent.

In order to determine the frequency of lightning stroke and the amount of property that is destroyed annually by that phenomenon, the Weather Bureau has undertaken to collect, through the cooperation of agents and adjusters of farmers' mutual insurance associations and many private persons, statistics of loss to farm property, including live stock in the fields. The data so collected will, in the course of time, afford means of determining an equitable rate on lightning risks.

#### FORECASTS AND WARNINGS.

##### DISTRICTS AND PERSONNEL.

The forecast districts remain the same as last year, viz, Oregon and Washington, Local Forecast Official B. S. Pague, Portland, Oreg., in charge; California, Nevada, and Arizona, Forecast Official W. H. Hammon, San Francisco, Cal., in charge; Montana, Wyoming, Colorado, Kansas, Nebraska, North Dakota, South Dakota, Minnesota, Wisconsin, Iowa, Missouri, Illinois, Indiana, and Michigan, comprising the Chicago forecast district, Prof. E. B. Garriott in charge, with Forecast Official H. J. Cox as first assistant. Forecasts for the remainder of the country were made at the central office in this city. Lieut. Col. H. H. C. Dunwoody, supervising forecast official, was in charge of the forecast division of the central office until May 31, 1898, on which date he returned to duty in the Signal Corps of the Army, after twenty-six years of useful service in the Weather Bureau, and its predecessor, the Signal Service. On Colonel Dunwoody's relief, the charge of the forecast division was intrusted to Prof. Park Morrill. Professor Morrill entered upon his new duties with great zeal and energy. He was especially active in attending to the details of the storm-warning service about to be established in the West Indies.

##### EFFICIENCY OF THE BUREAU.

The true measure and efficiency of the Weather Bureau is found in the promptness and accuracy with which notice of the approach and force of severe atmospheric disturbances is given. The efficiency of the bureau during the year just ended, judging from this criterion, was fully equal to the high standard of the previous year. While we were unable to discover new laws or principles, the application of

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<sup>1</sup> Michigan Insurance Reports, 1896-97.



which would tend to improve the accuracy of forecasts of minor disturbances, it was possible by the exercise of constant vigilance to issue warnings of all severe storms that occurred.

Prof. E. B. Garriott has prepared a brief account of the chief storms of the year and the work of the bureau in announcing them. Professor Garriott's full report is printed as an appendix to this report, from which the following has been summarized:

Four hurricanes, all of which were duly announced, visited the Atlantic and Gulf coasts during the fall of the year. The most severe of the four was that of October 23 to 26, which moved slowly from off the Florida coast to the vicinity of Hatteras, where it increased greatly in intensity, causing violent northeast gales along the coast as far northward as New England.

The duration of the storm in the vicinity of Hatteras enabled the bureau to make a definite prediction with regard to the tide at Norfolk, Va., where, owing to the low level of the city, much valuable property is liable to damage by inundation. In the case in question cotton and other property, valued at approximately \$850,000, were removed to places of safety. It was also reported to the Weather Bureau that between 800 and 900 vessels remained in port along the north Atlantic coast as a result of the warnings issued for this storm.

Three severe storms passed from the interior to the eastern seaboard during November, 1897. In one of these the ill-fated steamer *Idaho* with 19 of her crew of 21 was lost on Lake Erie. This vessel, it will be remembered, left Buffalo on the afternoon of the 5th in the face of storm signals which had been flying since daybreak. The Chicago Chronicle of November 12, 1897, commented on the wreck of the *Idaho* as follows:

The wreck of the steamer *Idaho*, with the loss of 19 lives, off Long Point, last week, points to a moral and adorns a tale for lake mariners. The disaster was the result of carelessness and temerity. The *Idaho* was 35 years old, and, though not exactly unseaworthy, should not have been exposed to a severe storm. The storm signals were flying when the boat put out of the port of Buffalo to make its way up Lake Erie. Captain Gillies trusted to his own judgment instead of to the warnings of science. He also trusted in the stoutness of an old craft not fitted for the severe tempests of the season. Small as it is, Lake Erie sees the worst storms that sweep across the lake basin.

We are accustomed to jeer at the Weather Bureau when unheralded storms carry devastation in their tracks across land and sea. Sometimes, perhaps often, forecasts of storms are not fulfilled, but this is only in the case of minor changes from calm to disturbance not seriously affecting navigation nor the pursuits of trade and labor on land and sea. Serious warnings are seldom without cause.

A remarkably violent storm of wind and snow swept over eastern New York and New England on January 31 and February 1, 1898. The greatest violence of the storm was manifested on the New England coast, on which nearly two score of mariners lost their lives and as many vessels were wrecked. At Boston heavy, damp snow, driven by a 50-mile gale from the northeast, completely prostrated overhead wires of all sorts and paralyzed transportation lines, both steam and electric, for several days. Warnings of this storm were given the widest possible distribution on the morning of the 31st.

Forecasts of freezing weather in Florida from January 2 to 4, 1898, also from February 2 to 4, were made in time to enable residents of that State to take such precautions as were possible to preserve early vegetables and fruit trees from destruction. Likewise in California during December, 1897, January and March, 1898, warnings well in advance of the unusually low temperatures that occurred in those months were

issued. Frost occurred in the fruit region of California quite frequently during March, 1898. In spite of the efforts made to protect fruit, then in blossom, much damage was done owing to the severity of the frost.

In the middle and northern districts of the country the winter was one of the mildest on record; cold waves were neither widespread nor severe.

#### FORECASTS OF FLOODS.

A brief description of the important floods of the year, of which there were five, will be found in the appendix to this report. But for the timely warnings issued by the Weather Bureau the losses from these floods would have been far more severe than they were. The flood in the Ohio in January was anticipated and the dates on which the danger line would be passed at important points were accurately indicated.

Warnings relative to the March flood in the Ohio were sent to Cincinnati on the 22d, and as the flood continued to increase in volume a warning was sent to Cairo on the 23d that the river would exceed the danger line considerably. This warning was supplemented each day, until the wave crest had passed, by others sent to all points between St. Louis and New Orleans.

At Cairo a stage of 48 feet was forecast for March 31, and on that date the gauge registered 47.6 feet; the rise continued and culminated on April 6, with a reading of 49.8 feet.

These timely warnings saved thousands of dollars to steamboat men, lumber dealers, and farmers living in the riparian districts. Levees were strengthened at the weaker places, and the levee authorities stationed men with material and implements for strengthening and building up as occasion might require.

Warnings regarding the flood in the Arkansas were issued and widely disseminated by telegraph, telephone, and through the mails and press. The Little Rock board of trade, appreciating the value of the warning and realizing the great damage that would result from the high stage indicated, chartered the steamer *Irma* and sent her 70 miles down the river, with instructions to stop at every landing and settlement, to blow her whistle and distribute the flood warnings, and to give every person who came to the landing full information, in order that every precaution to save life and property might be taken.

In addition to flood forecasts, warnings of low water were issued as the occasion required, and forecasts of this character were fully appreciated, as at certain low stages traffic is wholly or partially suspended, and at times it is absolutely essential that boatmen should know the low-water stage expected in order to intelligently prosecute their work.

#### WEATHER AND TEMPERATURE FORECASTS.

Turning now to the forecasts of weather and temperature—the minor atmospheric disturbances—we may note that no substantial increase in accuracy has been attained. In the present state of knowledge respecting minor atmospheric changes, it is not possible to forecast them with as great certainty as might be desired. Experiments have been made with kites, and instruments have been sent aloft to secure observations of pressure, temperature, and humidity, but as yet the observations are too few in number to determine their real value in weather forecasting. The upper air currents of summer, the only period during which observations were secured, are

feeble. Frequently, too, it has not been possible to make an ascension by reason of lack of movement in the surface currents. Observations are now being made as rapidly as circumstances will permit at 17 stations. The reduction of these observations is attended with some little uncertainty, but we hope to improve present methods and to eventually secure satisfactory data.

The discussion of the cloud observations, made in concert with foreign meteorological services during 1896-97, is in the hands of Prof. F. H. Bigelow. Professor Bigelow hopes to complete his work during the coming year. Fortunately, the kite observations now being made can be used to supplement the cloud observations. The former also promise practical results along a line of work hitherto unsuspected, viz, that of reducing barometric observations on the Rocky Mountain plateau to lower levels on either side, thus contributing to the better understanding of the actual pressure changes which occur in the plateau region.

#### DISTRIBUTION OF FORECASTS AND WARNINGS.

Forecasts and warnings were distributed with the utmost dispatch and in accordance with methods tried and proven by the experience of previous years. The daily press has contributed very greatly to the success that has attended our efforts to make a thorough distribution of the forecasts. Valuable aid has also been extended in disseminating special warnings of cold waves, storm winds, frosts, etc. The telephone appears to be a valuable medium of communication between the local observer and the public, and one that bids fair to eventually become of still greater usefulness in disseminating the warnings of the bureau. The valuable cooperation of numerous telephone companies is here acknowledged.

The total number of forecasts distributed during the year, exclusive of those published in the daily papers, was, approximately, 23,531,500, as shown by the table on page 203. Sixty-four per cent of the yearly distribution was by logotype cards sent through the mails or carried by messengers; 23 per cent by maps and bulletins; 10 per cent through the cooperation of railroad, telegraph, and telephone lines, while the remaining 3 per cent were distributed by telegraph and telephone at the expense of the bureau.

The State receiving the largest number of forecasts was Ohio, 2,157,300; the next largest, New York, 2,033,400, followed by Michigan, Illinois, Missouri, and Pennsylvania, in the order named.



*Annual distribution of forecasts and warnings.*

States and Territories.	At Government expense.			Without expense to the United States, by—				By maps and bulletins.	
	Forecasts and special warnings.	Special warnings only. <sup>a</sup>	Emergency warnings. <sup>a</sup>	Mail.	Telegraph or telephone.	Railroad bulletin.	Railroad train service.	Maps.	Bulletins.
Alabama	8,400	0	63	163,500	5,100	8,700	6,300	122,100	0
Arizona	600	1	0	0	2,400	0	0	0	6,000
Arkansas	9,300	4	58	122,400	10,800	1,800	0	50,100	9,600
California	25,200	22	3	609,600	33,300	104,700	0	200,400	5,400
Colorado	3,900	13	47	166,800	0	1,800	2,100	95,400	0
Connecticut	3,600	6	32	220,800	14,700	3,600	45,300	0	0
Delaware	1,500	0	6	9,600	0	6,600	0	0	0
District of Columbia	0	0	0	314,100	3,900	0	0	282,600	0
Florida	15,300	44	32	129,600	600	20,100	0	47,400	5,400
Georgia	17,700	40	82	249,900	600	31,800	12,300	94,200	0
Idaho	2,400	0	0	75,000	600	0	0	0	0
Illinois	22,200	24	383	831,000	7,500	82,200	137,700	405,300	0
Indiana	29,700	1	98	613,800	2,700	53,100	86,100	111,000	0
Indian Territory	2,400	1	0	27,000	300	0	0	0	0
Iowa	34,800	5	183	473,700	11,100	3,300	0	161,400	15,000
Kansas	12,300	3	142	155,400	6,000	38,400	4,500	3,300	18,300
Kentucky	13,500	53	76	192,900	35,700	10,200	0	96,300	0
Louisiana	8,700	24	6	136,500	3,300	900	0	144,900	0
Maine	7,800	1	13	296,400	2,400	6,900	23,100	32,700	0
Maryland	7,800	2	17	323,100	9,900	29,400	0	129,300	0
Massachusetts	6,600	16	32	570,900	6,600	0	120,300	288,600	0
Michigan	32,100	13	167	1,029,000	20,400	114,600	137,100	197,100	0
Minnesota	14,400	11	87	373,800	1,500	2,400	0	145,800	0
Mississippi	15,900	12	62	117,900	16,200	4,800	0	145,800	0
Missouri	26,700	6	191	945,900	30,900	32,100	18,000	339,000	0
Montana	4,800	0	16	125,100	4,800	0	0	0	17,400
Nebraska	18,600	4	147	279,300	600	3,300	0	77,100	8,100
Nevada	1,200	0	0	21,600	900	0	0	0	0
New Hampshire	3,300	0	13	98,100	0	3,000	9,300	0	0
New Jersey	10,200	24	90	324,300	17,100	52,200	0	0	0
New Mexico	2,700	0	0	9,000	900	1,200	0	0	0
New York	35,100	22	201	1,182,900	87,000	78,000	50,400	600,000	0
North Carolina	18,300	14	114	211,500	5,700	2,100	4,800	85,800	0
North Dakota	6,000	10	96	1,500	4,200	0	0	300	0
Ohio	48,300	106	197	1,631,100	76,200	24,600	5,100	372,000	0
Oklahoma	1,200	1	8	13,500	3,000	0	0	0	0
Oregon	7,200	0	0	183,600	2,700	0	31,200	129,300	600
Pennsylvania	19,200	12	105	606,000	182,700	207,000	0	204,300	0
Rhode Island	900	0	5	6,600	0	0	8,100	0	0
South Carolina	15,600	5	65	174,600	18,600	12,300	3,000	65,400	0
South Dakota	12,000	24	76	149,400	3,600	0	0	34,500	12,900
Tennessee	10,500	4	93	335,100	19,200	11,700	600	143,700	0
Texas	16,200	28	184	267,600	54,100	19,200	0	74,700	5,400
Utah	4,200	0	0	130,200	0	0	0	0	4,500
Vermont	3,300	1	16	152,400	17,100	3,000	3,900	0	0
Virginia	27,300	11	91	277,500	22,800	20,400	28,800	123,600	0
Washington	7,200	2	0	135,600	1,200	0	8,700	48,900	0
West Virginia	5,100	7	44	161,400	21,900	8,100	0	16,800	0
Wisconsin	26,100	14	134	378,900	11,100	300	4,800	164,400	0
Wyoming	2,100	1	6	4,200	1,500	5,400	0	6,900	0
Total	629,400	592	3,481	15,009,600	783,400	1,009,200	751,500	5,239,800	108,600
								23,531,500	

<sup>a</sup> As occasion requires.

## DISTRIBUTION OF WEATHER STATISTICS BY MAPS AND BULLETINS.

Five million two hundred and thirty-nine thousand eight hundred weather maps of all classes and 108,600 bulletins were distributed during the year, an increase of about 600,000. Each map or bulletin contains a daily forecast and statistics showing the weather conditions over some part of the United States. In the larger cities, as New York, Chicago, and Philadelphia, the map contains a large number of reports. It is almost as complete, in fact, as the one issued at the central office. The maps are used largely by boards of trade, business houses, and public offices, and a very considerable number

is issued to the schools and colleges of the country for purely educational purposes.

#### CLIMATIC WORK.

##### COTTON, CORN, AND WHEAT SERVICE.

The special service maintained in the cotton, corn, and wheat regions consists in reporting the daily temperature and rainfall at 129 stations in the cotton region and 131 in the corn and wheat region. No changes have been made in either of these services during the past year. The information collected is promptly telegraphed to important commercial centers and displayed by bulletin or otherwise in public places.

The climate and crop services of the various States and Territories were efficiently conducted during the year. Improved appliances for printing the monthly climate and crop reports in neat and uniform style have been installed in all but seven sections, viz, Idaho, Kansas, South Carolina, South Dakota, Utah, West Virginia, and Wyoming. The weekly bulletins of all of the sections except Nevada and Utah are printed in attractive form.

##### ESTABLISHMENT OF CLIMATE AND CROP SERVICE IN ALASKA.

The establishment of an agricultural experiment station in Alaska in April, 1898, led to the detail of an official of the Weather Bureau for duty in organizing a climate and crop service in that Territory. Meteorological observations have been made at but few places in Alaska since the withdrawal of Signal Service observers in 1887, and while the climate of the coast is fairly well determined, comparatively little is known of interior Alaskan climate, especially in summer.

The central station of the new service is located at Sitka, at which point continuous registers of wind velocity, sunshine, temperature, and pressure will be made. Check observations of standard instruments at 8 a. m. and 8 p. m., local mean time, will also be made.

##### SNOWFALL AT HIGH LEVELS IN WYOMING.

The section director of the climate and crop service of Wyoming, in cooperation with a special agent of the Office of the Experiment Stations of the Department of Agriculture, has been directed to make a careful study of the precipitation at voluntary stations in mountain regions, with a view of determining the amount of snowfall at high levels. He has been directed to secure as many additional voluntary observers as possible, and, wherever the reports are especially desirable, to arrange for paid observers. It is desired to know if a uniform ratio exists between precipitation at moderate levels and precipitation on high mountain ranges. The amount of snowfall determines in a great measure the volume of water available for the purpose of irrigation during the growing season of crops. If the ratio between mountain snowfall and the precipitation at lower levels be always the same, it will, of course, be possible to determine the amount of snow by the precipitation measured at our many stations on low levels, but if the ratio be not constant, it is apparent that accurate measurements of precipitation should be made on the elevated zone that supplies the streams of summer. From this and similar investigations it may be possible to make a fairly accurate estimate of the volume of water to be expected during each growing season. The subject is one that requires careful investigation, so that faulty conclusions be not reached.

## PUBLICATIONS.

The business of the publications division differed materially from the corresponding period that closed with June, 1897, only in the quantity of work done. The excess of impressions by letterpresses was 38 per cent, of completed copies 86 per cent, while the increased product of the lithograph presses exceeded 16 per cent.

The regular publications include the morning Weather Map, 850 copies; the Monthly Weather Review, 4,000 copies; the Climate and Crop Bulletin, weekly during the crop season, April to September, inclusive, and monthly during the rest of the year, 4,000 copies; the Meteorological Chart of the Great Lakes, monthly except December, January, and February, 3,000 copies; the Snow and Ice Chart, weekly during the winter season, 1,600 copies, and the River Bulletin, monthly since January, 1898, 650 copies.

## MONTHLY WEATHER REVIEW.

The Monthly Weather Review has been edited by Prof. Cleveland Abbe and published regularly, the date of issue being six or seven weeks after the close of the month to which it refers. Each number now contains sections contributed by the forecast, climate and crop, and records divisions, besides those by the librarian and the editor. In addition to these regular sections the bureau is indebted to numerous friends throughout the world for "special contributions" that are oftentimes of great interest to meteorologists, and especially to members of the service. The statistical matter in the Review forms a very comprehensive record of the climate of the several States and Territories. For reference and future investigation such a record is invaluable. The Review has also been enriched by regular monthly contributions of climatological data from Hawaii, Mexico, Jamaica, Haiti, Nicaragua, and Canada.

In size it has not exceeded the prescribed limit of 50 pages of text and 10 charts, but a larger percentage of the text has been printed in smaller type than was formerly used. There are usually 20 pages of tabular matter, 8 regular and several extra charts in each number.

The Annual Summary, together with the table of contents and index, completes each volume which, in accordance with past precedents, is known as the "Monthly Weather Review and Annual Summary" for the respective years.

## RAINFALL AND OUTFLOW OF THE GREAT LAKES.

In answer to a request from Mr. C. H. Keep, secretary of the Lake Carriers' Association, a report on the rainfall and outflow of the Great Lakes was made by Prof. C. Abbe and published in the Monthly Weather Review for April, 1898. The important result therein demonstrated is one that has, in fact, been long suspected, namely, that we know too little about the evaporation and the drainage from the watershed of the lake region to justify any minute conclusions. The "drainage or run-off" is a matter that should be determined by hydraulic engineers. In order that the Weather Bureau may respond satisfactorily to the public demands for information on evaporation, it will be necessary to establish a large number of evaporimeters in the lake region in such positions as to give the evaporation from the water surface of the lake as distinguished from the measurements in thermometer shelters usually made by meteorologists.



## MINUTE OSCILLATIONS OF THE GREAT LAKES.

Mr. F. H. Dennison, of the Canadian meteorological service, having established a continuous record, on a large scale, of the oscillations on Lake Ontario, has shown that minute temporary waves have such a connection with atmospheric conditions that they may, perhaps, be used to predict distant thunderstorms. These oscillations are of much interest from several points of view, and observations should be maintained at Weather Bureau stations in connection with the evaporimeters before mentioned, and in addition to any similar stations that may be maintained by the Chief of Engineers, United States Army, or by the Director of the United States Geological Survey.

## WEATHER BUREAU TELEGRAPH LINES.

At one time the Federal Government owned and operated about 5,000 miles of seacoast and frontier telegraph lines. In 1891, 633 miles of these lines, mainly on the seacoast, were turned over to the Weather Bureau as appropriate to a purely meteorological service. These lines traverse thinly settled regions or connect islands with the mainland by submarine cable at points where there is not enough commercial business to warrant the construction of a private line. The total revenue from Weather Bureau lines on account of commercial dispatches, during the year, was \$4,220.19, which sum was covered into the United States Treasury, as required by law.

These lines serve a double purpose: First, they enable the bureau to receive early information of changes in the weather at exposed points on our coast, and, second, they permit of the display of storm warnings near several of the great highways of vessels entering or leaving our ports; they also contribute largely to the safety of vessels navigating our shores, as evidenced by the specific cases quoted below.

(1) The British bark *Culdoon*, Captain Richter, Cape of Good Hope to Boston, went ashore March 23, 1898, on the south side of Nantucket Island. Wrecking companies were at once notified of the disaster and by speedy action the vessel and cargo, valued at \$100,000, were saved.

(2) The steamer *Tuscarora* and cargo, valued at \$700,000, went ashore on Middle Island, Lake Huron, during a dense fog, October 24, 1897. By means of the Weather Bureau system of cables and telegraph lines connecting Thunder Bay and Middle Island with the observer's office in Alpena, assistance was summoned and the steamer was saved after lightering 800 tons of merchandise.

## INSTRUCTION IN METEOROLOGY.

The instruction given in meteorology in the United States varies in its character according as this subject is considered as a part of a course in climatology and geology, or as a course in mathematics and physics. The former method of treatment is appropriate to high schools and to the needs of those who contemplate becoming observers in the Weather Bureau; the latter method of treatment is appropriate to universities and should fit one for the prosecution of important work in dynamic meteorology.

The importance of the subject has been kept in mind, especially in the assignment of observers to duty at points where there are colleges

or universities not already provided with instructors in meteorology. Prof. Cleveland Abbe, editor of the *Monthly Weather Review*, has been requested to prepare a report on the general condition of the subject in the United States. His report will doubtless stimulate interest in the matter and lead to a better conception of the standard of technical knowledge required for admission to the Weather Bureau service.

It is encouraging to be able to report that during the past year the courses in meteorology have been strengthened in a large number of high schools and academies.

The well-known course of Prof. Wm. M. Davis, in Harvard University, now devolves upon Mr. R. DeC. Ward, who has published an "Outline of requirements in meteorology," intended to serve as an aid to teachers in preparing students for examination in elementary meteorology, presented for admission to Harvard College and the Lawrence Scientific School.

A meteorological observatory has been erected at Columbia University, New York City, under the direction of Prof. William Hallock of the department of physics, and a complete course of instruction in this subject will undoubtedly follow.

A course of lectures on hydrodynamics in its application to the motions of the atmosphere has during the past year been offered by Prof. James McMahon of Cornell University.

Mr. O. L. Fassig, of the Weather Bureau, on duty at Baltimore, was assigned to the duty of instructor in climatology at the Johns Hopkins University, in addition to his other duties. The course of lectures given by Mr. Fassig has undoubtedly stimulated interest in climatic research at the university and throughout the State. Already plans have been made for the study of two special climatic problems of considerable economic importance.

#### IMPROVEMENT IN INSTRUMENTAL EQUIPMENT.

Early in the year a systematic plan for the betterment of the instrumental equipment of Weather Bureau stations was formulated, due regard being paid to the various local, educational, and other interests subserved at the several stations. This method secured a judicious distribution of the supplies that became available during the year, and, as a result, the equipment of all the stations is now in a more uniformly excellent condition than ever before.

The Weather Bureau offices at all important points are regularly visited by students and classes of local educational institutions. Advantage has been taken of the valuable opportunity thus afforded to instruct large numbers of pupils in the use of meteorological instruments as well as the methods of observation and general work of the Weather Bureau.

There are now in use at regular stations of the bureau, not including either the stations of the West Indies or the marine service on the Great Lakes, 90 registers (double and triple) recording velocity and direction of the wind, and, with few exceptions, sunshine and rainfall; 113 thermographs, recording the air temperature, and 105 barographs, recording air pressure. No other similar territory in the world is covered with such a complete equipment of instruments, recording climatic and meteorologic phenomena.

## RECOMMENDATION.

## NEED FOR ASSISTANT CHIEF OF BUREAU.

I regret to have to report that almost my entire time has been consumed in executive work, leaving little or no time for personal study and investigation. The executive work is constantly growing; in addition to the work involved here in the city of Washington, there are 165 outlying completely equipped meteorological stations, at the majority of which conditions continually arise that require careful executive consideration. While I have no desire to shift the responsibility for a portion of the work to another official, I feel that for the best interests of the service an assistant to the chief of bureau should be available in times of emergency and when the chief is absent from the city on official business.

## APPENDIX.

## STORMS, COLD WAVES, AND FLOODS OF THE YEAR.

By Prof. E. B. GARRIOTT.

## STORMS.

Four hurricanes visited the Atlantic and Gulf coasts. One of these was severe on the Texas coast September 13, 1897, where, owing to high winds and tides, 13 lives were lost, and the property loss was \$150,000. The second hurricane skirted the south Atlantic coast September 21, 1897, and disappeared south of New England September 24. Reports of incoming vessels showed that this storm was quite severe off Hatteras September 22. In advance of both these storms all shipping and ports in the Gulf of Mexico and along the Atlantic coast received, respectively, ample warning of high winds.

In October, 1897, two hurricanes moved northeastward along the Atlantic seaboard; the first from the 19th to the 21st, and the other from the 23d to 26th. Reports received indicated that the benefits derived from hurricane warnings, issued in connection with these storms, were very great, more particularly in the case of the storm of the 23d to 26th, which, from New York south to Hatteras, was the most violent and destructive that had occurred for years. Danger warnings and special telegraphic bulletins were displayed at all ports from twelve to twenty-four hours in advance of the hurricane, and the information was widely disseminated by means of the telephone, telegraph, and signal rockets at night, and as a result, few disasters to shipping occurred. Between eight and nine hundred vessels were reported to have remained in port at harbors on the Atlantic coast as a result of the signals and warnings. At Norfolk, Va., it was estimated that the warnings saved \$850,000 worth of cotton and other merchandise from damage by high tides.

Three severe storms occurred in November, 1897. The first of these advanced from Kansas to the Gulf of St. Lawrence from the 3d to 6th, causing high easterly to northerly winds on the upper lakes, and violent southerly to westerly gales on the lower lakes. This was the storm in which the ill-fated *Idaho* was lost on Lake Erie. This vessel left Buffalo harbor the afternoon of the 5th in the face of the storm signals which had been flying since daybreak. The second storm appeared in Kansas on the 7th, crossed the lower lake region on the 9th, and moved eastward off the New England coast on the 10th, its passage being attended by gales, for which signals were ordered well in advance of the storm's arrival. The third storm of November advanced from the region north of Montana to New England from the 9th to 12th, attended by gales over the Great Lakes and along the New England coast. The daily press at the various lake cities published many commendatory notes regarding the value of the warnings issued in connection with these storms, and the estimation in which they were held by the interests served.

The Chicago Chronicle of November 12, 1897, stated, editorially:

"The wreck of the steamer *Idaho*, with the loss of 19 lives, off Long Point, last week, points a moral and adorns a tale for lake mariners. The disaster was the



result of carelessness and temerity. The *Idaho* was 35 years old, and, though not exactly unseaworthy, should not have been exposed to a severe storm. The storm signals were flying when the boat put out of the port of Buffalo to make its way up Lake Erie. Captain Gillies trusted to his own judgment instead of to the warnings of science. He also trusted in the stoutness of an old craft, not fitted for the severe tempests of the season. Small as it is, Lake Erie sees the worst storms that sweep across the lake basin.

"We are accustomed to jeer at the Weather Bureau when unheralded storms carry devastation in their tracks across land and sea. Sometimes, perhaps often, forecasts of storms are not fulfilled; but this is only in case of minor changes from calm to disturbance not seriously affecting navigation nor the pursuits of trade and labor on land. Serious warnings are seldom without cause."

The Buffalo Times, November 14, 1897, contained the following:

"During the past week the local weather bureau has done navigation interests invaluable service. It has given warnings of the storms which have prevailed during the week, and undoubtedly has in this way saved two or three million dollars' worth of property, and nobody knows how many lives. Yesterday morning 50 vessels left port after waiting for the storm to blow over. Certainly the navigation interests of the Queen City of the Lakes could ill afford to do without the services of the Weather Bureau."

Detroit papers commented as follows:

[From Detroit Tribune, November 12, 1897.]

"The weather bureau at this point issued warnings of the approaching storm last Wednesday and at once ordered up storm signals at points along the entire chain of lakes. The orders were repeated yesterday morning. That much attention was paid to the signals is shown by the fact that the vessel passages at Detroit yesterday were among the lightest in number on record."

[From Detroit Free Press, November 12, 1897.]

"It is a fact deserving of praise that every storm this month was seen in the distance and predicted long before it reached the lakes. For a period of twenty-four to thirty-six hours ahead the inhabitants of the lake region have been told of the coming of each; and as it came closer and its immediate condition could be gauged the public have been given exact details, including direction and velocity of wind. Some men say this was a matter of luck. There is some excuse for this remark in view of the utter failure of predictions in times past. But there is another side to it. The bureau has, without doubt, been brought to a high state of efficiency. The chief and his assistants have profited by past experience just as every man of sense takes warning of what has gone before, and endeavors to improve on his record. The science of studying the origin and tracks of storms has been refined, and the process of refinement has by no means been completed. New instruments have had much to do with this, but study and application and reasonable deductions have had more."

"The natural result is the greater respect paid to the bureau, its bulletins, and charts than ever before. The November chart,<sup>1</sup> containing diagrams of the courses of past storms for that month, has jumped into popular favor. Requests are made for it every day by lake masters, owners, and others. More heed is taken of storm warnings, for the lake sailor has come to look on them as worthy of trust. The one great exception was the starting of the steamer *Idaho* from Buffalo last Friday. The predictions of that storm and its attendant conditions had been made many hours before."

Four storms of marked severity developed in the southwest in January, 1898, and, following nearly the same path, moved northeastward across the central valleys, the lower lake region, and the New England coast, accompanied by heavy snow in the northern portion of the regions traversed, and by high winds, causing considerable damage to various interests and interrupting traffic in northern Illinois, Wisconsin, and lower Michigan. The first storm, that of the 21st to 23d, caused unusually high tides on the Massachusetts coast, which resulted in considerable damage to seaport cities and towns in that region. Warnings were thoroughly distributed well in advance of these storms and were of undoubted value. The warnings of heavy snow for the States named were ample and very accurate.

A wind and snow storm of unusual violence passed over eastern New York and

<sup>1</sup> Meteorological chart of the Great Lakes.

New England January 31, and February 1, 1898. High wind, in connection with heavy snow, caused great destruction to shipping on the New England coast, and great damage to railroads, telegraph and telephone lines throughout eastern New York and New England. The warnings issued the morning of the 31st were given the widest possible distribution throughout the threatened regions, and, as shown by reports received, were of great benefit. Conservative and reliable estimates place the loss by the storm to electric and steam railroads, telegraph and telephone companies in the city of Boston and neighboring cities and towns, and to corporations and individuals generally at about \$1,500,000. The damage to shipping is estimated at from \$150,000 to \$200,000.

Severe storms also occurred on the New England coast February 15 and 16, and from February 18 to 22, 1898, a heavy snow and wind storm moved from Texas northeastward to New England. The warnings issued in connection with these storms were opportune, and the warnings of heavy snow and high north to northeast winds for the States of the upper Mississippi Valley and the upper lake region, made mainly in the interest of transportation companies, were fully verified, the snowfall in portions of the upper lake region exceeding 18 inches.

From March 2 to 5, 1898, a storm moved from the eastern part of the Gulf of Mexico to the New England coast. All shipping was well warned, and no serious losses were reported.

The severe storms of April, 1898, occurred over the lake region from the 13th to 15th and 18th to 20th, and along the Atlantic coast from the 26th to 29th. The coast storm was attended, by unusually severe gales and high tides on the middle Atlantic coast, but, owing to warnings disseminated, very little damage resulted.

#### COLD WAVES AND FROSTS.

The Florida freeze of January 2 to 4, 1898, was very destructive to early vegetables and caused considerable damage to citrus trees and pineapples. From the 2d to the 4th the following minimum temperatures were reported from Jacksonville, Tampa, and Jupiter, respectively: January 2, 24°, 28°, 30°; January 3, 26°, 26°, 30°; January 4, 38°, 38°, 34°. Warnings of these injurious conditions were sent from Washington, and although both of the days on which the messages were sent were holidays, making effective dissemination difficult, the warnings were, through the efforts of the Weather Bureau observers, by means of mail, telegraph, and telephone services, and the cooperation of railroad officials, very widely distributed throughout the threatened districts, and enabled the adoption of effective measures for the protection of crops.

Severe cold weather prevailed in Florida February 2 to 4, 1898, with the following minimum temperatures at Jacksonville, Tampa, and Jupiter, respectively: February 2, 26°, 31°, 40°; February 3, 32°, 38°, 50°; February 4, 34°, 34°, 52°. The amount reported saved by warnings in Florida by fruit and vegetable growers alone reached \$68,000, and these figures represent only a part of the total, there being hundreds of growers who were benefited, directly or indirectly, from whom no information could be obtained.

The Florida press complimented the Weather Bureau very highly upon the timely and accurate warnings given, and agreed in placing the estimate of fruit trees and vegetables saved thereby at thousands of dollars.

Heavy frosts occurred on the mornings of April 6 to 9, 1898, in the south Atlantic and Gulf States, with light frost on the 8th as far south as Jacksonville, Fla. Warnings of these frosts were issued from the central office the mornings of the 5th, 6th, and 7th, and extensively distributed throughout the regions named. The warnings were received in North Carolina fourteen hours, on the average, in advance of the frost, a period amply sufficient to employ methods for protecting crops. The saving to the berry crops was placed at thousands of dollars. Mr. H. T. Bauman, shipping master of the Fruit Growers' Association, estimates the saving in the State at \$100,000, and the approximate value of the crops protected, principally strawberries, at \$600,000 to \$700,000.

In December, 1897, and January, 1898, frost and freezing weather occurred in the citrus-fruit districts of California. On December 2 and 3 the temperature fell below freezing as far south as Los Angeles and Riverside counties, but the injury to the fruit interests was probably small. Warnings of these frosts were, in every instance, issued on the morning of the day preceding their occurrence. In March, 1898, frosts, in some instances quite destructive, occurred in the fruit regions of California nearly every night from the 12th to the 27th, inclusive, and on the 9th and 10th a severe norther, with gales on the coast, prevailed in California. Warnings of frost were distributed throughout the districts visited in advance of and during the period of frosts, and many efforts at protecting the fruit, then in



blossom, were made, which were not generally successful owing to the extreme severity of the frost. In some instances even grain was severely injured.

The cold waves of the middle and northern districts of the country were neither severe nor widespread, the most notable visitations of this class occurring over the west and northwest States March 22 to 23 and 24 to 28, 1898. All interests in the States lying between the Lake region and Rocky Mountains were warned of the approach of these cold waves, and an immense saving to property and stock on the cattle ranges of the north and northwest was effected.

#### FLOODS.

During the past fiscal year there were two floods of note in the Ohio River and its chief tributaries, the Cumberland and Tennessee; two in the Lower Mississippi River, and one in the Arkansas River.

#### *Floods in the Ohio.*

The first flood in the Ohio culminated at Cincinnati January 26, with a gauge reading of 52.2 feet; in the Cumberland at Nashville on January 23, with a reading of 38.6 feet, and in the Tennessee at Johnsonville January 29, with a reading of 29.1 feet, the danger line at these points being 45, 40, and 21 feet, respectively.

The tremendous outpour of the streams that empty into the Ohio within a few miles of the gauge at Cincinnati was chiefly responsible for the several successive rises that were recorded. The Ohio had reached 38 feet on the 14th, when the river interests in the bottoms began to prepare for prompt action in case of emergency. The danger line (36 feet) was passed at Point Pleasant on the 17th. The rise had only reached 44.6 feet at Cincinnati by midnight of the 17th, when, the local freshets having run out, a fall began. Steady and heavy rains on the 19th over the territory drained by the local streams caused a sudden rise in the Ohio at this point of 6 inches per hour, the danger line being passed on the 19th at midnight. This rise was a purely local one, attributed mainly to the Little Miami River. But for the concentration of several heavy rains, piling up a tremendous mass of water in front of Cincinnati, the storms of the month would hardly have swollen the river above the danger line.

Although the rise of 52.2 feet was unusual, submerging the valleys and lowlands, and causing inconvenience and expense in Cincinnati by necessitating the removal of goods and from a temporary cessation of business, river interests did not suffer materially from this flood.

A second and more disastrous flood occurred in the Ohio River in March, the rise beginning on the 15th, coming largely from the northern tributaries of the river. The rise was continuous, and on the 29th at Cincinnati reached a maximum height of 61.4 feet, the highest stage in March since the record began in 1858.

The conditions which prevailed in the Allegheny Valley and along the Monongahela, earlier in the month, due to the influence of fair and warmer weather, were followed by unusually heavy rains over the headwater tributaries of the Ohio, resulting in three freshets within the space of ten days, the first and last of which stopped a trifle short of the flood line, while the second, largely out of the Allegheny, reached a stage of 31 feet above low water on the 24th at Pittsburg, the highest record since February, 1891.

The heavy snowfall of the 1st and 2d of March is shown by the record of 5 inches at Cincinnati. This was followed by the fair weather already referred to, which caused the freshets in northern tributaries of the Ohio. Then came the heavy rains of the 17th, the river rising sharply by the morning of the 18th between Parkersburg and Louisville, and continuing to rise in consequence of the heavy and general rains, especially over its northern watershed. Four or five days later, about the time that the danger line (45 feet) was reached at Cincinnati, extraordinary rains occurred, which inundated a large portion of the States of Ohio and Indiana, flooding the valleys of the Muskingum, Scioto, and Miami. At noon on the 24th the 50-foot mark was reached at Cincinnati, and on the morning of the 25th a further rise of 2 feet was recorded, the water now encroaching upon the lower levels of the city. The Grand Central Railway depot was abandoned at midnight.

On the 26th and 27th the Great Miami and Indiana streams were again employed in carrying a great volume of water into the Lower Ohio, the rains of the last date causing an increased and prolonged rise in the vicinity of Cincinnati, the river coming to a stand at 61.4 feet at 3 a. m. on the 29th, remaining stationary until 7 a. m., when it began to recede slowly.



By this flood many interests suffered incalculable damage other than the business interests immediately affected along the river; labor suffered severely through enforced idleness; eight or nine railroads were, for the time being, abandoned. At Zanesville, on the Muskingum River, the damage to property was paralyzing, a loss of \$2,000,000 being estimated, while 4,000 people were driven from their homes.

#### *Floods in the Mississippi.*

The first flood in the Mississippi culminated at Cairo, Ill., on January 31, with a gauge reading of 44.4 feet. The second and more serious rise followed that which culminated in the Ohio at Cincinnati, March 23, with a gauge reading of 61.4 feet, the gauge indicating 49.8 at Cairo, April 6, on which date the highest point was reached.

The January flood was precipitated by the sudden rise from Cairo to Helena coming out of the Ohio and Cumberland rivers January 10 to 13, due to heavy rains over the entire watershed contiguous to these streams. At first the rise was only moderate, but the freshets in the small streams emptying into the main tributaries caused an increase at the rate of 2 to 3 feet daily. During eleven days, ending January 22, the amount added to the Memphis stage was 22.5 feet, while at Cairo and Helena the increase was over 27 feet. At Memphis the entire rise for the month amounted to 27.9 feet, the highest stage being 32.2 feet, reached on the 31st. In the Lower Mississippi the January rise was the most rapid in recent years, Vicksburg's rise at the close of the month being 30 feet and New Orleans about 9 feet.

The flood of the first week of April, while largely consequent upon the Ohio flood of the last days of March, was affected somewhat by the breaking up of ice, but more especially by heavy rainfalls which commenced about the 10th of the month and continued to the end, resulting in a total precipitation of more than twice the usual quantity for the month, filling and overflowing main tributaries.

As an example, at Hannibal the total rainfall on the 27th was 3.42 inches, which caused an unprecedented overflow of the waters of Bear Creek, flooding 100 residences, washing out railroad bridges, and damaging roadbeds, with other destruction.

On April 1 the Mississippi River was above danger line from Cairo to Memphis, and a week later the Helena gauge indicated a like condition. The rise at Memphis averaged one-half foot per day until the 11th, when it stood at a 37.3-foot stage, remaining stationary two days before the fall set in. The total height of the flood wave was 27 feet, and this was reached at Memphis in twenty-seven days from the time of its first appearance at that place. The water was above danger line at Memphis twenty-two days. At New Orleans the danger line was reached on the 18th, and the forecasts of the Weather Bureau were to the effect that a nearly 50-foot stage would be reached at Vicksburg, and not to exceed 17 feet at New Orleans. Planters and others along the river were fully prepared, therefore, and while the water reached the exact stage anticipated, there were no serious overflows.

#### *Flood in the Arkansas.*

The flood in the Arkansas that occurred during May was the greatest known in years. On the 7th the river at Fort Smith, Ark., attained the unprecedented height of 35 feet. The crest of this rise reached Little Rock on the 11th, with a maximum stage of 27.5 feet, which was attained at 1.30 p. m. of that date. The danger line was passed on the 6th, and was exceeded during ten consecutive days thereafter. In consequence of the continued rapid rise in the Upper Arkansas and its tributaries, flood warnings were issued on the 5th forecasting a stage of 27.5 feet at Little Rock, or just 0.4 foot lower than the highest stage reached in 1892, when the lowlands along the Arkansas from Little Rock to the mouth were overflowed and devastated. The damage done along the Arkansas west of Little Rock was greater than from any previous flood. In the immediate neighborhood of Fort Smith the loss was from \$2,000 to \$2,500. Notwithstanding the precautions taken and the extra work done, levees were broken, resulting in immense overflows, by which thousands of acres of growing crops were destroyed. The immediate cause of the flood was the general and heavy precipitation during the first few days of the month in the valleys drained by the Arkansas and its tributaries.











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THE SHAW-WALKER CO., MUSKOGON 116679



